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ABSTRACT

This curriculum guide provides six units of instruction on basic welding. Addressed in the individual units of instruction are the following topics: employment opportunities for welders, welding safety and first aid, welding tools and equipment, basic metals and metallurgy, basic math and measuring, and procedures for applying for a welding job. Each unit contains some or all of the following: performance objectives, suggested activities for teachers and students, information sheets, assignment sheets, job sheets, visual aids, tests, and answers to the tests. (MN)

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INTRODUCTION TO WELDING

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Introduction to Welding

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FOREWORD

Because their classroom experience helps them to accurately identify needs in existing curriculum, outstanding instructors from each of the MAVCC member states serve on a MAVCC Resource Committee. Charged with planning and approving materials, the Resource Committee also includes selected representatives from industry whose input helps direct learning objectives toward actual job-getting skills that industry needs.

The instructor-industry input is nowhere more apparent than in *Introduction to Welding*. Both groups demanded that welding safety be properly introduced and repeatedly accented. Both instructors and industry representatives pinpointed needs for better student skills in math and metallurgy Industry wanted students to have a better appreciation for the world of work, and an emphasis on the fact that along with the monetary rewards of a job goes an equal amount of basic responsibility. And preparing and interviewing for a welding job is so different from job interviewing in other occupations that industry wanted materials that more realistically reflected the actual procedure.

So the committee process has made *Introduction to Welding* much more than a simple orientation for students planning welding careers. It is a text that both instructors and students will continue to use as a "reference" for a multitude of other welding activities both in training and in the real world.

Instructional materials in this publication are written in terms of student performance, and the criterion-referenced tests provide for uniform measurement of student progress. The competency-based format should free welding instructors to spend more time in planning other classroom and shop activities to personalize the learning process and better motivate students in their learning endeavors.

Department of Labor projections indicate that the demand for welders will increase beyond the average for other trades during the 1980's. *Introduction to Welding* presents the fundamentals for students willing to meet the challenge and advance their careers in an industry that rewards talent with good pay and better lives.

Larry Barnhardt, Chairman
Board of Directors
Mid-America Vocational
Curriculum Consortium

PREFACE

In its *Dictionary of Occupational Titles*, the Department of Labor suggests that a Combination Welder should be able ". . . to fabricate or repair . . . according to layouts, blueprints, . . . [with a] variety of arc and gas welding equipment." There are other requirements, but those brief remarks are enough to merit a well-rounded training program, and MAVCC has attempted to provide curriculum equal to the ambitious task.

Introduction to Welding is the first book in MAVCC's new seven-text welding series. The six others are: *Oxyacetylene Welding and Cutting; SMAW, Shielded Metal Arc Welding; GTAW, Gas Tungsten Arc Welding; GMAW, Gas Metal Arc Welding and FCAW, Flux-Cored Arc Welding; Shielded Metal Arc Pipe Welding; and Welding Blueprint Reading and Layout.*

Introduction to Welding is basic to each of the other books in the series, but beyond that point, text selection provides instructors with an impressive flexibility for planning local programs to fit local needs.

Whether it's an Ag program dedicated to basic skills in oxyacetylene and stick, or a long-range program designed to produce a multi-skilled combination welder, MAVCC's is the combination series that can best accomplish the task.

Ann Benson
Executive Director
Mid-America Vocational
Curriculum Consortium

ACKNOWLEDGEMENTS

Appreciation is extended to the many individuals and companies who contributed their time, talent, and materials to the successful development of *Introduction to Welding*.

The Resource Committee that planned and approved the text deserves a special thank you. That committee includes:

Ron Carpenter, Twin Lakes Vo-Tech, Harrison, Arkansas
Patrick Mulville, Pike's Peak Community College, Colorado Springs, Colorado
Rick Cowman, Des Moines Area Community College, Ankeny, Iowa
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Walon Holt, Oklahoma State Department of Vo-Tech Education, Stillwater, Oklahoma
Floyd Silvers, Welding, Metallurgy, and Testing Consultant, Tulsa, Oklahoma

Several manufacturers and suppliers of welding tools, equipment, and materials have contributed illustrations and other valuable materials that assisted significantly in the development process. In cases where it is appropriate, their names are noted throughout the text, and many materials published by those manufacturers and suppliers appear as references for instructors who wish to enhance their programs.

We extend a special acknowledgement to the American Welding Society whose publications were frequently referenced for the sake of technical accuracy.

Appreciation is also extended to the artists Robert Randall and Regina Beaney of the Graphics Division, Oklahoma State Department of Vocational-Technical Education, for their hard work with the project, and to members of the Oklahoma State Vo-Tech Print Shop for their excellent service in printing the text.

The text was phototypeset in the Oklahoma State Vo-Tech Communications Center, and for their excellent contribution, thank yous go to the phototypesetters Lori White, Dona Landreth, Rose Primeaux, and Allison McLaughlin.

USE OF THIS PUBLICATION

Instructional Units

Introduction to Welding includes six units. Each instructional unit includes some or all of the basic components of a unit of instruction: performance objectives, suggested activities for teachers and students, information sheets, assignment sheets, job sheets, visual aids, tests, and answers to the test. Units are planned for more than one lesson or class period of instruction.

Careful study of each instructional unit by the teacher will help to determine:

A. The amount of material that can be covered in each class period
B. The skills which must be demonstrated

    1. Supplies needed
    2. Equipment needed
    3. Amount of practice needed
    4. Amount of class time needed for demonstrations

C. Supplementary materials such as pamphlets or filmstrips that must be ordered
D. Resource people who must be contacted

Objectives

Each unit of instruction is based on performance objectives. These objectives state the goals of the course, thus providing a sense of direction and accomplishment for the student.

Performance objectives are stated in two forms: unit objectives, stating the subject matter to be covered in a unit of instruction; and specific objectives, stating the student performance necessary to reach the unit objective.

Since the objectives of the unit provide direction for the teaching-learning process, it is important for the teacher and students to have a common understanding of the intent of the objectives. A limited number of performance terms have been used in the objectives for this curriculum to assist in promoting the effectiveness of the communication among all individuals using the materials.

Reading of the objectives by the student should be followed by a class discussion to answer any questions concerning performance requirements for each instructional unit.

Teachers should feel free to add objectives which will fit the material to the needs of the students and community. When teachers add objectives, they should remember to supply the needed information, assignment and/or job sheets, and criterion tests.

Suggested Activities for the Instructor

Each unit of instruction has a suggested activities sheet outlining steps to follow in accomplishing specific objectives. Duties of instructors will vary according to the particular unit; however, for best use of the material they should include the following: provide students with objective sheet, information sheet, assignment sheets, and job sheets; preview filmstrips, make transparencies, and arrange for resource materials and people; discuss unit and specific objectives and information sheet; give test. Teachers are encouraged to use any additional instructional activities and teaching methods to aid students in accomplishing the objectives.

Information Sheets

Information sheets provide content essential for meeting the cognitive (knowledge) objectives in the unit. The teacher will find that the information sheets serve as an excellent guide for presenting the background knowledge necessary to develop the skill specified in the unit objective.

Students should read the information sheets before the information is discussed in class. Students may take additional notes on the information sheets.

Transparency Masters

Transparency masters provide information in a special way. The students may see as well as hear the material being presented, thus reinforcing the learning process. Transparencies may present new information or they may reinforce information presented in the information sheets. They are particularly effective when identification is necessary.

Transparencies should be made and placed in the notebook where they will be immediately available for use. Transparencies direct the class's attention to the topic of discussion. They should be left on the screen only when topics shown are under discussion.

Assignment Sheets

Assignment sheets give direction to study and furnish practice for paper and pencil activities to develop the knowledge which is a necessary prerequisite to skill development. These may be given to the student for completion in class or used for homework assignments. Answer sheets are provided which may be used by the student and/or teacher for checking student progress.

Job Sheets

Job sheets are an important segment of each unit. The instructor should be able to, and in most situations should demonstrate the skills outlined in the job sheets. Procedures outlined in the job sheets give direction to the skill being taught and allow both student and teacher to check student progress toward the accomplishment of the skill. Job sheets provide a ready outline for students to follow if they have missed a demonstration. Job sheets also furnish potential employers with a picture of the skills being taught and the performances which might reasonably be expected from a person who has had this training.

Test and Evaluation

Paper-pencil and performance tests have been constructed to measure student achievement of each objective listed in the unit of instruction. Individual test items may be pulled out and used as a short test to determine student achievement of a particular objective. This kind of testing may be used as a daily quiz and will help the teacher spot difficulties being encountered by students in their efforts to accomplish the unit objective. Test items for objectives added by the teacher should be constructed and added to the test.

Test Answers

Test answers are provided for each unit. These may be used by the teacher and/or student for checking student achievement of the objectives.

INTRODUCTION TO WELDING

Instructional/Task Analysis

JOB TRAINING: Psychomotor (What the worker should be able to do)	RELATED INFORMATION: Cognitive (What the worker should know)
UNIT I: WELDING ORIENTATION	
	1. Terms and definitions
	2. Periods of arc welding history and their historical importance
	3. Standards and their importance to the welding industry
	4. Where welders work
	5. Job opportunities for welders
	6. Welding processes and their functions
	7. Difference between braze welding and brazing
	8. Cutting processes and their functions
	9. The importance of welding and cutting processes
	10. Personal requirements for a successful welder
	11. Attitudes that promote job advancement
	12. Occupational advancements available to welders
	13. Occupational advancements available to welders with some college
	14. Abbreviations for professional organizations that benefit welders
15. Complete a personal information work sheet	

JOB TRAINING: Psychomotor (What the worker should be able to do)	RELATED INFORMATION: Cognitive (What the worker should know)

UNIT II: WELDING SAFETY AND FIRST AID

1. Terms and definitions
2. Safety color codes and their uses
3. Accident prevention signs, their colors and uses
4. Accident prevention tags, their colors and uses
5. The ALWAYS rules for welding safety
6. The NEVER rules for welding safety
7. Shop safety rules
8. Eye safety
9. Good housekeeping rules
10. Factors contributing to back injury and their causes
11. Steps in lifting safely
12. Things OSHA expects of an employer
13. Things OSHA expects of an employee
14. Rules for personal safety
15. Personal physical and hygiene requirements
16. Types of fires and their classifications
17. Types of fire extinguishers and their uses
18. Types of fire extinguishers and their recommended operations
19. Fire safety rules

JOB TRAINING: Psychomotor (What the worker should be able to do)	RELATED INFORMATION: Cognitive (What the worker should know)
	20. Three components of the fire triangle
	21. Handling and safe storage of gases
	22. Rules for handling gas cylinders safely
	23. Electrical safety
	24. First aid for victims of electrical shock
	25. First aid requirements for common welding injuries
	26. Ways to recognize shock
	27. Steps in treating shock
	28. Steps in controlling bleeding
	29. Types of bleeding and their characteristics
	30. Pressure points for checking bleeding
	31. First aid for eye injury
	32. General guidelines for first aid emergencies
33. Complete a student safety pledge	
34. Select proper first aid procedures	

UNIT III: WELDING TOOLS AND EQUIPMENT

	1. Terms and definitions
	2. Driving and chipping tools, their characteristics and uses
	3. Chisels, punches, and pry bars and their uses
	4. Files, their uses, basic shapes, and cuts

JOB TRAINING: Psychomotor (What the worker should be able to do)	RELATED INFORMATION: Cognitive (What the worker should know)
	5. Wire brushes, their types and uses
	6. Holding and anchoring tools, their characteristics and uses
	7. Alignment tools and their uses
	8. Types of jacks
	9. Pulling and lifting tools, their characteristics and uses
	10. Measuring tools, their characteristics and uses
	11. Turning tools and wrenches and their uses
	12. Pliers and their uses
	13. Manual cutting and shaping tools and their uses
	14. Power equipment, its characteristics and uses
	15. Positioning equipment, its characteristics and uses
	16. Basic rules for safe use of hand tools
	17. Basic rules for safe use of power tools and equipment
	18. The number one rule for maintaining a tool or piece of equipment
19. Identify basic hand tools	
20. Identify basic power tools and equipment	

JOB TRAINING:
Psychomotor
(What the worker should
be able to do)

RELATED INFORMATION:
Cognitive
(What the worker should know)

UNIT IV: BASIC METALS AND METALLURGY

1. Terms and definitions
2. Reasons for proper metal identification
3. Basic categories of metals
4. Alloys and their characteristics
5. Tests for metal identification and their procedures
6. Basic elements of metallurgy
7. Mechanical properties of metals and their characteristics
8. Types of mechanical strengths and their meanings
9. Physical properties of metals and their characteristics
10. The sub-zero temperature range and its effects on ferrous metals
11. The black heat range and its effects on ferrous metals
12. The red heat range and its effects on ferrous metals
13. The white heat range and its effects on ferrous metals
14. Ways of testing properties of metals
15. Principal alloying agents of steel and their characteristics
16. Metals and ways to identify them by appearance
17. Systems for identifying steel

JOB TRAINING:
Psychomotor
(What the worker should
be able to do)

RELATED INFORMATION:
Cognitive
(What the worker should know)

18. Carbon steel classifications, characteristics, and uses

19. Alloy steel classifications, characteristics, and uses

20. Iron classifications, characteristics, and uses

21. Aluminum, its characteristics and uses

22. AA system of identifying aluminum and aluminum alloys

23. The AA temper designation for aluminum

24. Other aluminum abbreviations and their meanings

25. Steps in identifying aluminum

26. Chemical tests for identifying aluminum alloys

27. Other nonferrous metals and typical uses

28. Standard metal shapes available for welding

29. Equipment requirements for spark testing

30. Terminology used in spark testing

31. Residual stresses and what they mean

32. Causes of residual stresses and distortion

33. Heat applications and their uses in weld quality control

34. Situations where preheating is usually required

JOB TRAINING: Psychomotor (What the worker should be able to do)	RELATED INFORMATION: Cognitive (What the worker should know)
	35. Methods of preheating and postheating
	36. Torch preheating techniques and their applications
	37. Types of steels and their recommended preheat temperatures
	38. Temperature-sensing devices and their uses
	39. Ways to control distortion in welding
	40. Ways to control distortion with restraining devices
	41. Guidelines for correcting distortion in welded components
	42. Procedure for straightening a distorted steel member
43. Identify selected metals by appearance, color, and corrosion characteristics	
44. Identify metal shapes used for welding	
45. Prepare a working reference for straightening a distorted steel member	
46. Conduct magnet tests to identify common metals used for welding	
47. Conduct spark tests to identify common metals used for welding	
48. Conduct chisel tests to identify common metals used for welding	

JOB TRAINING: Psychomotor (What the worker should be able to do)	RELATED INFORMATION: Cognitive (What the worker should know)

UNIT V: BASIC MATH AND MEASURING

JOB TRAINING	RELATED INFORMATION
	1. Terms and definitions
	2. Basic mathematical terms and their definitions
	3. Advantages of decimal equivalent and conversion charts
	4. Uses for fractions
	5. Uses for decimals
	6. Methods for expressing fractions and decimal equivalents
	7. Percent and its uses
	8. Units of measure found on rules
	9. Steps for reading a rule
	10. Steps in finding mid-point of a given distance
	11. Formulas for perimeters
	12. Perimeters for rectangles, squares, and triangles
	13. Basic geometric figures
	14. Areas of basic geometric figures
	15. Measurements for circles
	16. Methods of sizing commonly used steel stock
17. Add, subtract, multiply, and divide fractions	
18. Add, subtract, multiply, and divide decimal equivalents	

JOB TRAINING: Psychomotor (What the worker should be able to do)	RELATED INFORMATION: Cognitive (What the worker should know)
19. Convert fractions to decimal form	
20. Write fractions as decimals and percents	
21. Write percents as fractions and decimals	
22. Write decimals as fractions and percents	
23. Make conversions with the decimal equivalent and inches to decimal conversion charts	
24. Use the English-Metric Conversion Chart	
25. Measure distance with 1", 1/2", and 1/4" graduations	
26. Measure distance with 1/4" and 1/8" graduations	
27. Measure distance with 1/8" graduations	
28. Measure distance with 1/16" graduations	
29. Measure given line segments with 1/16" graduations	
30. Measure dimensions of given objects with a rule	
31. Measure given lines and objects with a rule	
32. Use a rule to draw lines and objects to given specifications	
33. Find the mid-point of given lines and figures	

JOB TRAINING:
Psychomotor
(What the worker should be able to do)

RELATED INFORMATION:
Cognitive
(What the worker should know)

34. Calculate the perimeters of given rectangles

35. Calculate the perimeters of given squares

36. Calculate the perimeters of given triangles

37. Calculate the areas of given parallelograms

38. Calculate the areas of given rectangles

39. Calculate the areas of given squares

40. Calculate the areas of given triangles

41. Calculate the areas of given rhombuses

42. Calculate the areas of given trapezoids

43. Calculate the circumferences of given circles

44. Calculate the areas of given circles

45. Adjust a bevel square to a 45° angle using a framing square, a combination square, and a protractor

46. Use a combination square to form 90° and 45° angles and to draw parallel lines on selected metal stock

UNIT VI: APPLYING FOR A WELDING JOB

1. Terms and definitions

2. Reasons why a worker needs a social security card

3. Information required on a social security card application

JOB TRAINING: Psychomotor (What the worker should be able to do)	RELATED INFORMATION: Cognitive (What the worker should know)
	4. Guidelines for filling out a social security card application
	5. Reasons why beginning welders do get jobs
	6. Ways to find a job
	7. What employers look for in a welding job applicant
	8. Why welding job applicants need to be well prepared
	9. Guidelines for preparing an effective resumé
	10. Effective ways to arrange for a job interview
	11. Guidelines for filling out a job application
	12. Guidelines for making a good impression at a welding job interview
	13. Guidelines for succeeding with a welding test
	14. Guidelines for completing a medical questionnaire
15. Complete a social security card application	
16. Prepare a personal resumé	
17. Write a letter requesting a job interview	
18. Complete an application for employment as a welder	
19. Complete a medical questionnaire	

Tools, Equipment, and Materials List

Basic hand tools

- Chipping hammer
- Fitter's hammer
- Mallet
- Sledge hammer
- Ball peen hammer
- Assorted chisels
- Drift punch
- Center punch
- Prick punch
- Aligning pry bar
- Assorted files
- Card file
- Wire brushes
- Vise-Grip clamps
- Bar clamps
- C-clamps
- Spring clamps
- Vise
- Platen table and accessories
- Wedges
- Clip plates or dogs
- Flat bar
- Yoke
- Strongback
- Assorted jacks
- Turnbuckles
- Come-along
- Plate dogs
- Slings
- Adjustable wrench
- Open-end wrench
- Box-end wrench
- Pipe wrench
- Cylinder wrench
- Torch wrench
- Socket wrench and handles
- Assorted screwdrivers
- Allen wrench set
- Assorted pliers
- Hacksaw
- Sheet metal snips
- Bolt cutter
- Pipe cutter

Measuring tools

- Pocket tape
- Metal gauges
- Drill point gauge
- Wing dividers
- Calipers
- Rules
- Levels
- Plumb bob
- Chalk line
- Bevel square
- Combination square
- Steel tape
- Framing square
- Micrometer

Cutting and shaping tools

- Angle iron cutter, notcher, and bender
- Hossfeld bender
- Beverly shear
- Anvil
- Tap and die set

Power equipment

- Power shears
- Power roll
- Drill press
- Pedestal grinder
- Pedestal buffer
- Angle and straight grinders
- Belt and disc sander
- Hand drill
- Heavy-duty hand drill
- Cut-off saw
- Vertical band saw
- Power hacksaw
- Reciprocating saw
- Press brake
- Turning rolls
- Manipulator
- Positioner

Safety equipment

- Fire extinguisher(s)
- Safety glasses
- Face shield
- Welding and cutting goggles

    - Welding helmet
    - Assorted welding lenses

- Assorted structural shapes
- Oxyacetylene welding and cutting rig
- Welding machines
- Welding cables, hoses, and guns
    - SMAW
    - GTAW
    - GMAW
    - FCAW
- Assorted electrodes

ALPHABETICAL LIST OF REFERENCES USED
IN DEVELOPING THIS TEXT

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WELDING ORIENTATION
UNIT I

UNIT OBJECTIVE

After completion of this unit, the student should be able to discuss welding history, welding standards, and job opportunities for welders. The student should also be able to list personal requirements for a successful welder, attitudes that promote job advancement, and complete a personal information worksheet. This knowledge will be evidenced by correctly performing the procedures outlined in the assignment sheet and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to welding orientation with their correct definitions.
2. Match periods of arc welding history with their historical importance.
3. Select true statements concerning standards and their importance to the welding industry.
4. Complete statements concerning where welders work.
5. Select true statements concerning job opportunities for welders.
6. Match welding processes with their functions.
7. Differentiate between braze welding and brazing.
8. Match cutting processes with their functions.
9. Complete statements concerning the importance of welding and cutting processes.
10. Complete a list of personal requirements for a successful welder.
11. Complete a list of attitudes that promote job advancement.
12. List occupational advancements available to welders.
13. List occupational advancements available to welders with some college.
14. Match professional organizations that benefit welders with their abbreviations.
15. Complete a personal information work sheet.

WELDING ORIENTATION
UNIT I

SUGGESTED ACTIVITIES

I. Provide student with objective sheet.

II. Provide student with information and assignment sheets.

III. Make transparencies.

IV. Discuss unit and specific objectives.

V. Discuss information sheet.

VI. Invite a local or area officer of the American Welding Society to talk to the class about AWS activities and the concept of standards in the welding industry.

VII. Consider starting an AWS student chapter at your school and discuss with a local AWS official how this can be accomplished.

VIII. Conduct a tour of school facilities to acquaint students with the total school environment and places like the student office, counselor's office, break rooms, and other special areas they should know how to find.

IX. Have the VICA coordinator at your school talk to your students about the objectives of VICA, the benefits of being a VICA member, and the procedure for VICA membership.

X. Determine the number of students who do not have social security card numbers and have them apply for a social security card by using the procedures outlined in unit VI of this text, "Applying for a Welding Job."

XI. Give test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

  A. Objective sheet

  B. Information sheet

  C. Transparency masters

    1. TM 1 — Master Chart of Welding and Allied Processes

    2. TM 2 — Golden Rules

  D. Assignment Sheet #1 — Complete a Personal Information Worksheet

  E. Test

INSTRUCTIONAL MATERIALS

F. Answers to test

II. References:

A. *Occupational Outlook Handbook, 1982-83 Edition.* Washington, D.C.: U.S. Department of Labor, Bureau of Labor Statistics, 1982.

B. *The Procedure Handbook of Arc Welding,* Cleveland, OH 44117: The Lincoln Electric Company, 1973.

C. *Welding Procedure and Performance Qualification.* Miami, FL 33126: American Welding Society, 1977.

D. Sacks,Raymond J. *Welding: Principles and Practices, Revised.* Peoria, IL 61615: Chas. A. Bennett Co., Inc., 1981.

E. *Pocket Welding Guide.* Troy, OH 45373: Hobart Brothers Company, 1980.

WELDING ORIENTATION
UNIT I

INFORMATION SHEET

I. Terms and definitions

   A. Welding — The process of joining two metals together by heating them with a torch or an electric arc with or without a filler metal

   B. Base metal — Any metal to be welded or cut

   C. Fusion — The joining of metals by melting them together with or without filler metal

II. Periods of arc welding history and historical importance

   A. Early welding history — Metals were joined by electric fusion as early as 1782 in Germany, and English, French, and Russian experiments in the 1800's established the principles of striking and maintaining an electric arc with controlled voltage and the first arc welding process

   B. Early 1900 welding history — The first patent was issued for a covered electrode and arc-welding methods were used to weld ship hulls and produce armaments in World War I

   C. Middle 1900 welding history — A new process greatly reduced the cost of covered electrodes and arc welding applications expanded into the aircraft, manufacturing, and construction industries

   D. Later 1900 welding history — World War II inspired many advances in arc welding technology, improvements in electrodes, improved applications of shielding gases, and higher speed applications for the thousands of all-welded ships produced in World War II, in aircraft production, and in armaments

   E. Recent welding history — New arc welding processes such as GTAW and GMAW were developed to meet the special needs of industrial production and there were ongoing improvements and advances in electrode technology

   F. Modern welding history — Advances continued in electric arc welding and brought such processes as arc spot welding, atomic-hydrogen welding, electro-slag and electro-gas welding, plasma-arc welding and cutting, submerged arc welding, and yet other processes to answer special industry needs

INFORMATION SHEET

III. Standards and their importance to the welding industry

   A. As the welding industry grew, it became evident that standards were needed for manufactured items used in welding, and for standards to test the qualification of welders

   B. In 1936, the Committee on Standard Qualification Procedure issued its first report to the American Welding Society calling for a general qualification standard for procedures and performances of welders

   C. As the needs presented themselves, other standards were issued by such groups as the American Iron and Steel Institute, American Petroleum Institute, Society of Automotive Engineers, and the Aluminum Association

IV. Where welders work

   A. 75% of all welders help manufacture durable goods ranging from trucks and ships to smaller parts for consumer goods

   B. 25% of all welders help construct bridges, buildings, pipelines, or work in industrial maintenance

V. Job opportunities for welders

   A. Employment for welders is expected to increase as fast if not faster than the average for all occupations through the 1980's

   (NOTE: Statistically, the average increase for all occupations for the 1980's is projected to be 17-25%, but for welders, the projection is for an increase of 28-49%.)

   B. New welders will continue to be needed to replace other welders who move to other occupations or retire

   C. Job opportunities for welders will vary strongly by geographic region and demand for welders will be strongest in the Sunbelt and Western States

   D. Many production lines will use robotic welding systems, but skilled welders will not be affected by automation

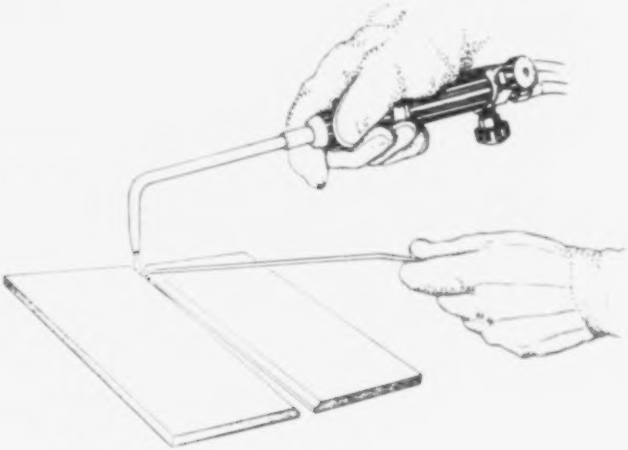
   E. Earnings for welders will continue to be above the average for nonsupervisory occupations

INFORMATION SHEET

VI. Welding processes and their functions (Transparency 1)

A. OAW — Oxyacetylene welding, a process for joining metals by heating them to melting point and allowing the melted portions to flow together with or without the use of a filler metal (Figure 1)

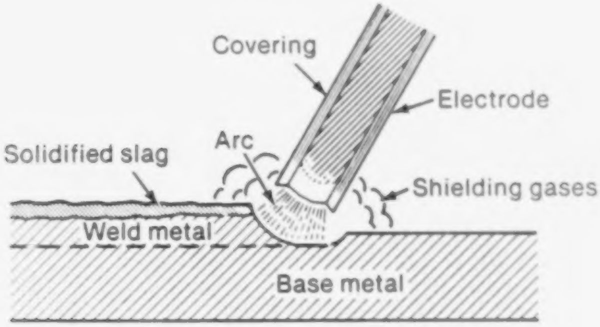
FIGURE 1



Courtesy Union Carbide Corporation, Linde Division

B. SMAW — Shielded metal arc welding, a process for joining metals with heat from an electric arc between a base metal and a flux-covered electrode that provides both shielding and filler metal as it is consumed (referred to as "stick" welding) (Figure 2)

FIGURE 2

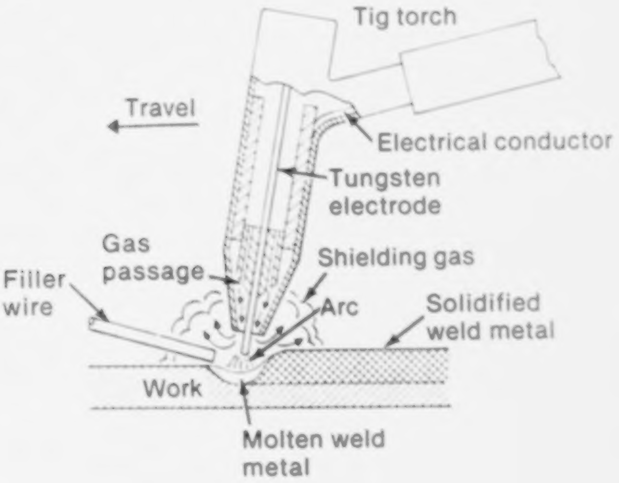

Covering
Electrode
Solidified slag
Arc
Shielding gases
Weld metal
Base metal

Courtesy Lincoln Electric Company

INFORMATION SHEET

C. GTAW — Gas tungsten arc welding, a process for joining metals by heating with an arc between a workpiece and a nonconsumable tungsten electrode in the presence of a shielding gas (referred to as "TIG" welding) (Figure 3)

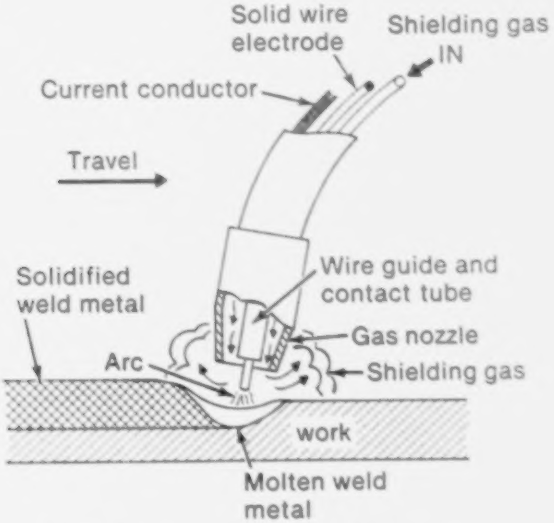
FIGURE 3


Tig torch
Travel
Electrical conductor
Tungsten electrode
Gas passage
Shielding gas
Filler wire
Arc
Solidified weld metal
Work
Molten weld metal

Courtesy Lincoln Electric Company

D. GMAW — Gas metal arc welding, a process for joining metals by heating with an arc between a workpiece and a consumable electrode in the form of a continuously-fed wire in the presence of a shielding gas (referred to as "MIG" welding) (Figure 4)

FIGURE 4

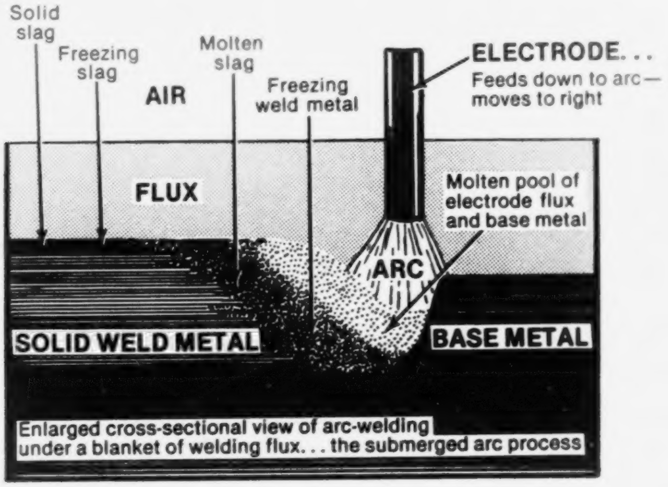

Solid wire electrode
Shielding gas IN
Current conductor
Travel
Solidified weld metal
Wire guide and contact tube
Gas nozzle
Arc
Shielding gas
work
Molten weld metal

Courtesy Lincoln Electric Company

INFORMATION SHEET

E. SAW — Submerged arc welding, a process for joining metals by heating with an arc between a workpiece and a bare metal electrode continuously-fed into a covering shield of granulated flux (Figure 5)

FIGURE 5


Solid slag
Freezing slag
AIR
Molten slag
Freezing weld metal
ELECTRODE...
Feeds down to arc— moves to right
FLUX
Molten pool of electrode flux and base metal
ARC
SOLID WELD METAL
BASE METAL
Enlarged cross-sectional view of arc-welding under a blanket of welding flux... the submerged arc process

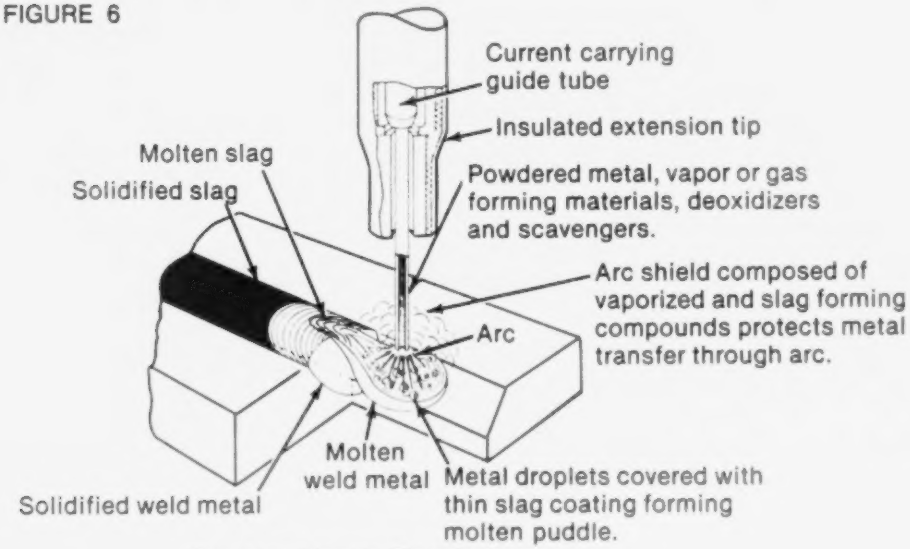
Courtesy Lincoln Electric Company

INFORMATION SHEET

F. FCAW — Flux-cored arc welding, a process for joining metals by heating with an arc between a workpiece and a consumable electrode continuously-fed in the presence of a shielding flux contained inside the electrode (Figure 6)

(NOTE: There is also a dual-shielded process in flux-cored arc welding which uses shielding from both the electrode flux and a shielding gas.)

FIGURE 6


Current carrying guide tube
Insulated extension tip
Molten slag
Solidified slag
Powdered metal, vapor or gas forming materials, deoxidizers and scavengers.
Arc shield composed of vaporized and slag forming compounds protects metal transfer through arc.
Arc
Molten weld metal
Solidified weld metal
Metal droplets covered with thin slag coating forming molten puddle.

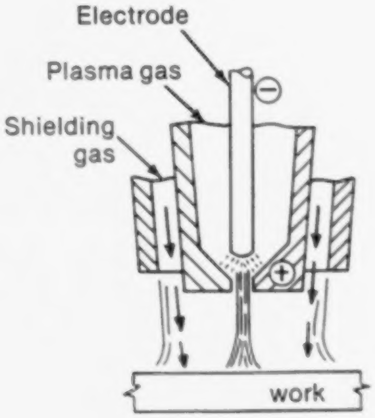
Courtesy Lincoln Electric Company

INFORMATION SHEET

G. PAW — Plasma arc welding, a process for joining metals by heating with a restricted arc between an electrode and a workpiece or a constricting nozzle with shielding usually provided from a hot, ionized gas projected from the nozzle as a plasma jet (Figure 7)

(NOTE: Plasma arc welding sometimes employs an additional shielding gas, and the principle of the high energy density of the plasma jet is also used effectively in PAC, plasma arc cutting.)

FIGURE 7



Courtesy Lincoln Electric Company

VII. Braze welding and brazing

A. Brazing — A general group of welding processes that use a nonferrous filler metal with a melting point over 800°F but lower than the melting point of the base metals, and distribution of the filler metal is achieved through capillary attraction

B. Braze welding — A general group of welding processes that use a nonferrous filler metal with a melting point over 800°F but lower than the melting point of the base metals, and distribution of the filler metal is achieved through weld design and not by capillary attraction

VIII. Cutting processes and their functions

A. OFC — Oxygen fuel cutting, a general group of cutting processes that use oxygen and other selected gases which form a chemical reaction with a base metal at elevated temperatures to make a cut

(NOTE: When oxygen is used in combination with acetylene for cutting it is called oxyacetylene cutting, OFC-A; oxygen and hydrogen, OFC-H; oxygen and propane, OFC-P; and oxygen and natural gas, OFC-N.)

INFORMATION SHEET

B. AC — Arc cutting, a general group of cutting processes that use the heat of an arc between a base metal and an electrode to make a cut

(NOTE: Forms of arc cutting include carbon-arc cutting, CAC, and plasma-arc cutting, PAC.)

IX. The importance of welding and cutting processes

A. Oxyacetylene welding and cutting — The first widely used welding and cutting process, and still used frequently because the equipment required is readily portable and handy for maintenance welding in industry and agriculture

(NOTE: Students planning a welding career will benefit from learning oxyacetylene welding and cutting because it helps develop eye and hand coordination and the manual dexterity required to properly perform many other welding processes.)

B. Shielded metal arc welding (SMAW) — The first widely used arc welding process, popular because of its higher rate of metal deposition than oxyacetylene, and still frequently used because the equipment is readily portable, adaptable to many welding applications, relatively inexpensive, and can be used in adverse weather conditions

C. Gas tungsten arc welding (GTAW) — A welding process developed to answer the needs for high-purity welds where control of heat must be precise to accomplish critical applications with lightweight metals such as aluminum

D. Gas metal arc welding (GMAW) — A welding process developed to answer the needs for high productivity in production line manufacturing, and popular because of its adaptability to all kinds of metals and reduced distortion factor which produces high quality welds

(NOTE: Because of its versatility, GMAW welding is popular with semi-automatic, automatic, and robotic applications.)

X. Personal requirements for a successful welder

A. Manual dexterity, good eyesight, and good eye-hand coordination

B. Ability to concentrate on detailed work for long periods

C. Physically able to bend, stoop, and work in awkward positions

D. Basic skills in math and blueprint reading

E. Basic skills in welding processes

INFORMATION SHEET

F. Basic skills in metallurgy, the properties of metals

G. A good attitude toward the job and the employer

XI. Attitudes that promote job advancement (Transparency 2)

A. Enthusiasm and interest — This includes taking pride in your work and being willing to do more than your share when needed

B. Dedication and dependability — This involves good work habits, including regular attendance and being on time, and the ability to understand and follow instructions

C. Alertness, quickness of mind — You should always look for unsafe situations that could injure workers or damage property, and you should constantly look for more efficient working practices

D. Honesty and integrity — Employees should give truthful information both to customers and to their employer

E. Desire to work — Do things on your own initiative, and don't wait to be told when you know what to do

F. Ability to work with others — Have a positive attitude and control your emotions

G. Desire to improve oneself — Good employees always look for ways to increase their knowledge; this benefits both the employer and employee

H. Put in a day's work for a day's pay — Be conscious of waste in materials and time

I. Be safety conscious — Follow safety regulations and develop safe working habits. Horseplay is not allowed

J. Be willing to start at the ground level — Rome wasn't built in a day and neither are good welders, so accept the jobs beginners are assigned, develop well-rounded skills, and the advancements will take care of themselves

XII. Occupational advancements available to welders

A. Welding machine or robotic welder operator

B. Combination welder

C. Welder-fitter

D. Specialist welder

INFORMATION SHEET

E. Welding supervisor

F. Welding analyst

G. Welding technician

H. Welding instructor

I. Welding foreman

J. Welding superintendent

K. Shop owner

L. Equipment salesperson

M. Sales troubleshooter

N. Welding inspector

XIII. Occupational advancements available to welders with some college

A. Welding engineer

B. Welding development engineer

C. Welding research engineer

D. Technical editor

E. College level welding teacher

F. Corporation executive

G. Quality control supervisor

H. Metallurgist

(NOTE: Many welders have advanced their job opportunities by taking evening classes at local colleges, junior colleges, or vocational-technical schools, by joining professional organizations and regularly attending meetings, and by reading trade journals to keep up-to-date with the advancing welding industry.)

INFORMATION SHEET

XIV. Professional organizations that benefit welders and their abbreviations

A. **AA — Aluminum Association**
818 Connecticut N.W.
Washington, DC 20006
(202) 862-5100

B. **AISI — American Iron and Steel Institute**
1000 16th St. N.W.
Washington, DC 20036
(202) 452-7100

C. **ANSI — American National Standards Institute**
1430 Broadway
New York, NY 10018
(212) 354-3300

D. **API — American Petroleum Institute**
2101 L St. N.W.
Washington, DC 20037
(202)457-7000

E. **ASM — American Society for Metals**
Route 87
Metals Park, OH 44073
(216) 338-5151

F. **ASME — American Society of Mechanical Engineers**
345 E. 47th St.
New York, NY 10017
(212) 644-7722

G. **AWS — American Welding Society**
550 N.W. LeJeune Road
P.O. Box 351040
Miami, FL 33126
(305) 443-9353

H. **NSC — National Safety Council**
444 N. Michigan Ave.
Chicago, IL 60611
(312) 527-4800

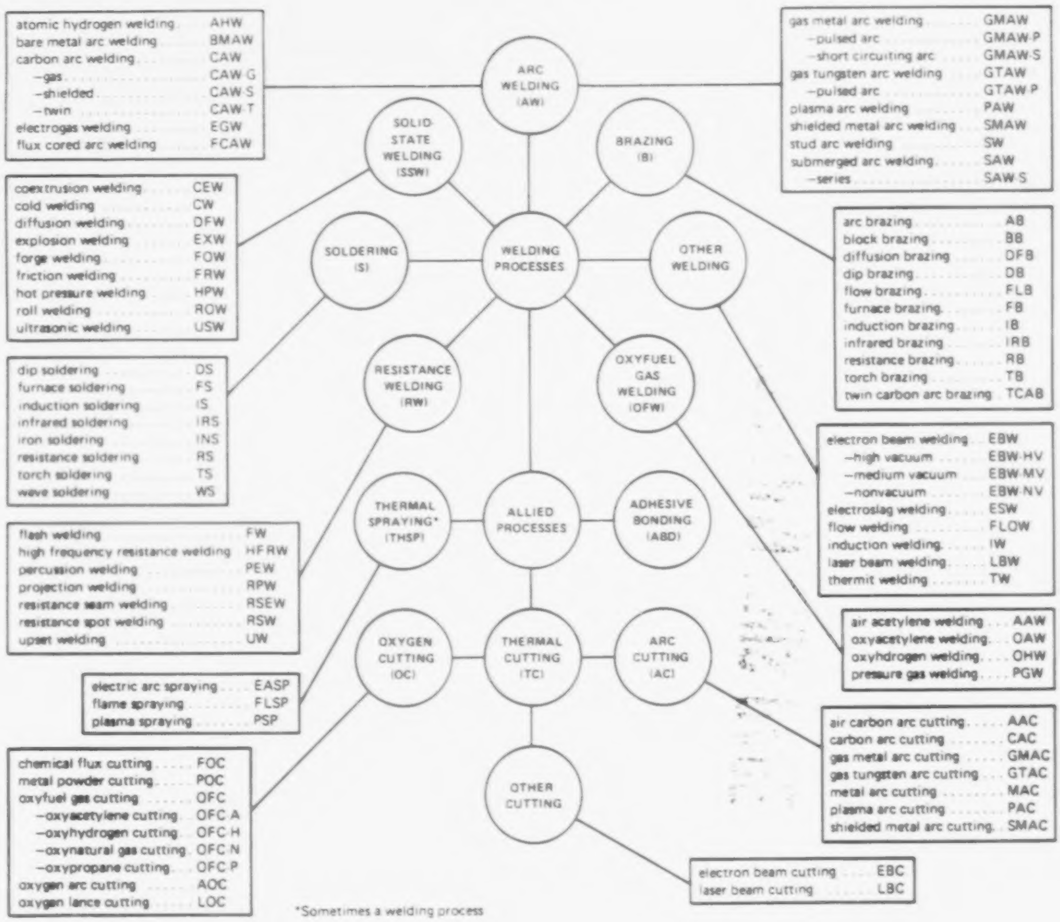
I. **NWSA — National Welding Supply Association**
1900 Arch St.
Philadelphia, PA 19103
(215) 564-3484

INFORMATION SHEET

J. SAE — **Society of Automotive Engineers**
400 Commonwealth Dr.
Warrendale, PA 15096
(412) 776-4841

K. SME — **Society of Manufacturing Engineers**
One SME Drive
P.O. Box 930
Dearborn, MI 48128
(313) 271-1500

MASTER CHART OF WELDING AND ALLIED PROCESSES


ARC WELDING (AW)
SOLID-STATE WELDING (SSW)
BRAZING (B)
SOLDERING (S)
WELDING PROCESSES
OTHER WELDING
RESISTANCE WELDING (RW)
OXYFUEL GAS WELDING (OFW)
THERMAL SPRAYING* (THSP)
ALLIED PROCESSES
ADHESIVE BONDING (ABD)
OXYGEN CUTTING (OC)
THERMAL CUTTING (TC)
ARC CUTTING (AC)
OTHER CUTTING

atomic hydrogen welding	AHW
bare metal arc welding	BMAW
carbon arc welding	CAW
—gas	CAW-G
—shielded	CAW-S
—twin	CAW-T
electrogas welding	EGW
flux cored arc welding	FCAW

gas metal arc welding	GMAW
—pulsed arc	GMAW-P
—short circuiting arc	GMAW-S
gas tungsten arc welding	GTAW
—pulsed arc	GTAW-P
plasma arc welding	PAW
shielded metal arc welding	SMAW
stud arc welding	SW
submerged arc welding	SAW
—series	SAW-S

coextrusion welding	CEW
cold welding	CW
diffusion welding	DFW
explosion welding	EXW
forge welding	FOW
friction welding	FRW
hot pressure welding	HPW
roll welding	ROW
ultrasonic welding	USW

arc brazing	AB
block brazing	BB
diffusion brazing	DFB
dip brazing	DB
flow brazing	FLB
furnace brazing	FB
induction brazing	IB
infrared brazing	IRB
resistance brazing	RB
torch brazing	TB
twin carbon arc brazing	TCAB

dip soldering	DS
furnace soldering	FS
induction soldering	IS
infrared soldering	IRS
iron soldering	INS
resistance soldering	RS
torch soldering	TS
wave soldering	WS

electron beam welding	EBW
—high vacuum	EBW-HV
—medium vacuum	EBW-MV
—nonvacuum	EBW-NV
electroslag welding	ESW
flow welding	FLOW
induction welding	IW
laser beam welding	LBW
thermit welding	TW

flash welding	FW
high frequency resistance welding	HFRW
percussion welding	PEW
projection welding	RPW
resistance seam welding	RSEW
resistance spot welding	RSW
upset welding	UW

air acetylene welding	AAW
oxyacetylene welding	OAW
oxyhydrogen welding	OHW
pressure gas welding	PGW

electric arc spraying	EASP
flame spraying	FLSP
plasma spraying	PSP

air carbon arc cutting	AAC
carbon arc cutting	CAC
gas metal arc cutting	GMAC
gas tungsten arc cutting	GTAC
metal arc cutting	MAC
plasma arc cutting	PAC
shielded metal arc cutting	SMAC

chemical flux cutting	FOC
metal powder cutting	POC
oxyfuel gas cutting	OFC
—oxyacetylene cutting	OFC-A
—oxyhydrogen cutting	OFC-H
—oxynatural gas cutting	OFC-N
—oxypropane cutting	OFC-P
oxygen arc cutting	AOC
oxygen lance cutting	LOC

electron beam cutting	EBC
laser beam cutting	LBC

*Sometimes a welding process

Courtesy American Welding Society

GOLDEN RULES

If You Open It, Close It.
If You Turn It On, Turn It Off.
If You Unlock It, Lock It.
If You Break It, Repair It.
If Your Can't Fix It,
Call Someone Who Can.
If You Borrow It, Return It.
If You Use It, Take Care Of It.
If You Make A Mess, Clean It Up.
If You Move It, Put It Back.
If You Don't Know How To Operate It,
Leave It Alone.
If It Doesn't Concern You,
Mind Your Own Business.

WELDING ORIENTATION
UNIT I

ASSIGNMENT SHEET #1 — COMPLETE A PERSONAL INFORMATION WORKSHEET

Directions: The following information is needed for administrative purposes, and to assure that parents or guardians can be properly notified in the event of an emergency.

Name: ______________________________ Age: __________

Home Address: Street ______________________________

City ____________________ State ________ Zip Code ________

Grade Classification: ______________________________

Occupational Objective: ______________________________

Social Security Number: ______________________________

Name of Parents or Guardian: ______________________________

Address: ______________________________

Home Phone: ______________________________

Occupation of Parents or Guardian: ______________________________

Family Doctor: ____________________ Telephone: ____________

Follow Up Information (list any special circumstances, other persons, or other telephone numbers that should be used in the event of an emergency and be sure to include a telephone number where a parent or guardian can be reached at their place of work):

____

____

____

WELDING ORIENTATION
UNIT I

NAME ______________________

TEST

1. Match the terms on the right with their correct definitions.

_____a. The process of joining two metals together by heating them with a torch or an electric arc with or without a filler metal

_____b. Any metal to be welded or cut

_____c. The joining of metals by melting them together with or without filler metal

1. Base metal
2. Fusion
3. Welding

2. Match periods of arc welding history with their historical importance.

_____a. Metals were joined by electric fusion as early as 1782 in Germany, and English, French, and Russian experiments in the 1800's established the principles of striking and maintaining an electric arc with controlled voltage and the first arc welding process

_____b. The first patent was issued for a covered electrode and arc-welding methods were used to weld ship hulls and produce armaments in World War I

_____c. A new process greatly reduced the cost of covered electrodes and arc welding applications expanded into the aircraft, manufacturing, and construction industries

_____d. World War II inspired many advances in arc welding technology, improvements in electrodes, improved applications of shielding gases, and higher speed applications for the thousands of all-welded ships produced in World War II, in aircraft production, and in armaments

1. Later 1900 welding history
2. Modern welding history
3. Middle 1900 welding history
4. Early welding history

TEST

_____e. New arc welding processes such as GTAW and GMAW were developed to meet the special needs of industrial production and there were ongoing improvements and advances in electrode technology

_____f. Advances continued in electric arc welding and brought such processes as arc spot welding, atomic-hydrogen welding, electroslag and electro-gas welding, plasma-arc welding and cutting, submerged arc welding, and yet other processes to answer special industry needs

5. Recent welding history
6. Early 1900 welding history

3. Select true statements concerning standards and their importance to the welding industry by placing an "X" in the appropriate blanks.

_____a. As the welding industry grew, it became evident that standards were needed for manufactured items used in welding, and for standards to test the qualification of welders

_____b. In 1955, the Committee on Standard Qualification Procedure issued its first report to the American Welding Society calling for a general qualification standard for procedures and performances of welders

_____c. As the needs presented themselves, other standards were issued by such groups as the American Iron and Steel Institute, American Petroleum Institute, Society of Automotive Engineers, and the Aluminum Association

4. Complete statements concerning where welders work by circling the word(s) that best completes each statement.

a. 75% of all welders help manufacture (tool parts, durable goods) ranging from trucks to ships to smaller parts for (export, consumer goods)

b. 25% of all welders help construct bridges, buildings, pipelines, or work in (automobile assembly lines, industrial maintenance)

5. Select true statements concerning job opportunities for welders by placing an "X" in the appropriate blanks.

_____a. Employment for welders is expected to decrease slightly through the 1980's

_____b. New welders will continue to be needed to replace other welders who move to other occupations or retire

TEST

______c. Job opportunities for welders will vary strongly by geographic region and demand for welders will be strongest in the eastern industrial states

______d. Many production lines will use robotic welding systems, but skilled welders will not be affected by automation

______e. Earnings for welders will continue to be above the average for nonsupervisory occupations

6. Match welding processes with their functions.

______a. A process for joining metals by heating them to melting point and allowing the melted portions to flow together with or without the use of a filler metal

______b. A process for joining metals with heat from an electric arc between a base metal and a flux-covered electrode that provides both shielding and filler metal as it is consumed

______c. A process for joining metals by heating with an arc between a workpiece and a nonconsumable tungsten electrode in the presence of a shielding gas

______d. A process for joining metals by heating with an arc between a workpiece and a consumable electrode in the form of a continuously-fed wire in the presence of a shielding gas

______e. A process for joining metals by heating with an arc between a workpiece and a bare metal electrode continuously-fed into a covering shield of granulated flux

______f. A process for joining metals by heating with an arc between a workpiece and a consumable electrode continuously-fed in the presence of a shielding flux contained inside the electrode

______g. A process for joining metals by heating with a restricted arc between an electrode and a workpiece or a constricting nozzle with shielding usually provided from a hot, ionized gas projected from the nozzle as a plasma jet

1. FCAW
2. GTAW
3. OAW
4. PAW
5. SMAW
6. SAW
7. GMAW

TEST

7. Differentiate between braze welding and brazing by placing an "X" beside the definition for brazing.

______a. A general group of welding processes that use a nonferrous filler metal with a melting point over 800°F but lower than the melting point of the base metals, and distribution of the filler metal is achieved through capillary attraction

______b. A general group of welding processes that use a nonferrous filler metal with a melting point over 800°F but lower than the melting point of the base metals, and distribution of the filler metal is achieved through weld design and not by capillary attraction

8. Match cutting processes with their functions.

______a. A general group of cutting processes that use oxygen and other selected gases which form a chemical reaction with a base metal at elevated temperatures to make a cut

______b. A general group of cutting processes that use the heat of an arc between a base metal and an electrode to make a cut

1. AC
2. OFC

9. Complete statements concerning the importance of welding and cutting processes by circling the word(s) that best completes each statement.

a. Oxyacetylene welding and cutting — The first widely used welding and cutting process, and still used frequently because the equipment required is readily portable and handy for maintenance welding in (industry and agriculture, airplane repair)

b. Shielded metal arc welding (SMAW) — The (first, second) widely used arc welding process, popular because of its higher rate of metal deposition than oxyacetylene, and still frequently used because the equipment is readily portable, adaptable to many welding applications, relatively inexpensive, and can be used in adverse weather conditions

c. Gas tungsten arc welding (GTAW) — A welding process developed to answer the needs for high-purity welds where control of heat must be precise to accomplish critical applications with (lightweight metals such as aluminum, heavier metals such as cast iron)

d. Gas metal arc welding (GMAW) — A welding process developed to answer the needs for high productivity in production line manufacturing, and popular because of its adaptability to all kinds of metals and (reduced distortion, high speed) factor which produces high quality welds

TEST

10. Complete the following list of personal requirements for a successful welder.

    a. Manual dexterity, good eyesight, and good ____________________

    b. Ability to concentrate on ____________ for long periods

    c. Physically able to bend, stoop, and work in ____________ positions

    d. Basic skills in ____________ and blueprint reading

    e. Basic skills in ____________ processes

    f. Basic skills in ____________, the properties of metals

    g. A good attitude toward the ____________________

11. Complete the following list of attitudes that promote job advancement.

    a. Enthusiasm and interest — This includes taking pride in your work and being willing to do ________________ when needed

    b. Dedication and dependability — This involves good work habits, including regular attendance and being on time, and the ability to ____________ and ____________ instructions

    c. Alertness, quickness of mind — You should always look for unsafe situations that could injure workers or damage property, and you should constantly look for more ____________ working practices

    d. Honesty and integrity — Employees should give ____________ information both to customers and to their employer

    e. Desire to work — Do things on your own initiative, and don't ________________ when you know what to do

    f. Ability to work with others — Have a positive attitude and control ________________

    g. Desire to improve oneself — Good employees always look for ways to increase ____________; this benefits both the employer and employee

    h. Put in a day's work for a day's pay — Be conscious of ____________ in materials and time

    i. Be safety conscious — Follow safety regulations and develop safe working habits. ____________ is not allowed

    j. Be willing to start at the ground level — Rome wasn't built in a day and neither are good welders, so accept the jobs beginners are assigned, develop well-rounded skills, and the advancements will ____________________

TEST

12. List five occupational advancements available to welders.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

13. List three occupational advancements available to welders with some college.

a. ______________________________

b. ______________________________

c. ______________________________

14. Match professional organizations that benefit welders with their abbreviations.

______a.	Aluminum Association	1. ASME
______b.	American Iron and Steel Institute	2. NSC
______c.	American National Standards Institute	3. SME
______d.	American Petroleum Institute	4. AA
______e.	American Society for Metals	5. AWS
______f.	American Society of Mechanical Engineers	6. AISI
______g.	American Welding Society	7. SAE
______h.	National Safety Council	8. ASM
______i.	National Welding Supply Association	9. ANSI
______j.	Society of Automotive Engineers	10. API
______k.	Society of Manufacturing Engineers	11. NWSA

15. Complete a personal information work sheet.

(NOTE: If this activity has not been accomplished prior to the test, ask your instructor when it should be completed.)

WELDING ORIENTATION
UNIT I

ANSWERS TO TEST

1. a. 3
   b. 1
   c. 2

2. a. 4
   b. 6
   c. 3
   d. 1
   e. 5
   f. 2

3. a, c

4. a. Durable goods, consumer goods
   b. Industrial maintenance

5. b, d, e

6. a. 3
   b. 5
   c. 2
   d. 7
   e. 6
   f. 1
   g. 4

7. a

8. a. 2
   b. 1

9. a. Industry and agriculture
   b. First
   c. Lightweight metals such as aluminum
   d. Reduced distortion

10. a. Eye-hand coordination
    b. Detailed work
    c. Awkward
    d. Math
    e. Welding
    f. Metallurgy
    g. The job and the employer

11. a. More than your share
    b. Understand, follow
    c. Efficient
    d. Truthful
    e. Wait to be told
    f. Your emotions

ANSWERS TO TEST

g. Their knowledge
h. Waste
i. Horseplay
j. Take care of themselves

12. Any five of the following:

a. Welding machine or robotic welder operator
b. Combination welder
c. Welder-fitter
d. Specialist welder
e. Welding supervisor
f. Welding analyst
g. Welding technician
h. Welding instructor
i. Welding foreman
j. Welding superintendent
k. Shop owner
l. Equipment salesperson
m. Sales troubleshooter
n. Welding inspector

13. Any three of the following:

a. Welding engineer
b. Welding development engineer
c. Welding research engineer
d. Technical editor
e. College level welding teacher
f. Corporation executive
g. Quality control supervisor
h. Metallurgist

14.	a.	4	g.	5
	b.	6	h.	2
	c.	9	i.	11
	d.	10	j.	7
	e.	8	k.	3
	f.	1		

15. Evaluated to the satisfaction of the instructor

WELDING SAFETY AND FIRST AID
UNIT II

UNIT OBJECTIVE

After completion of this unit, the student should be able to relate color-coded safety signs and tags to their uses, discuss important rules for basic welding safety, select extinguishers for given classes of fires, and list first aid requirements for common welding injuries. The student should complete a student safety pledge and be able to select proper first aid procedures for given emergency situations. This knowledge will be evidenced by correctly completing the procedures outlined in the assignment sheets and by scoring 100% on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to welding safety and first aid with their correct definitions.
2. Match safety color codes with their uses.
3. Match accident prevention signs with their colors and uses.
4. Match accident prevention tags with their colors and uses.
5. Complete statements concerning the ALWAYS rules for welding safety.
6. Complete statements concerning the NEVER rules for welding safety.
7. Select true statements concerning shop safety rules.
8. Complete statements concerning eye safety.
9. Complete statements concerning good housekeeping rules.
10. Match factors contributing to back injuries with their causes.
11. Arrange in order the steps in lifting safely.
12. List two things OSHA expects of an employer.
13. List two things OSHA expects of an employee.
14. Complete statements concerning rules for personal safety.
15. Select true statements concerning personal physical and hygiene requirements.
16. Match types of fires with their classifications.

OBJECTIVE SHEET

17. Match types of fire extinguishers with their uses.
18. Match types of fire extinguishers with their recommended operations.
19. Select true statements concerning fire safety rules.
20. Define the three components of the fire triangle.
21. Complete statements concerning handling and safe storage of gases.
22. Select true statements concerning rules for handling gas cylinders safely.
23. Complete statements concerning electrical safety.
24. Solve a problem concerning first aid for a victim of electrical shock.
25. Select true statements concerning first aid requirements for common welding injuries.
26. Complete statements concerning ways to recognize shock.
27. Arrange in order the steps in treating shock.
28. Arrange in order the steps in controlling bleeding.
29. Match types of bleeding with their characteristics.
30. Identify pressure points for checking bleeding.
31. Select true statements concerning first aid for eye injuries.
32. Complete statements concerning general guidelines for first aid emergencies.
33. Complete a student safety pledge.
34. Select proper first aid procedures.

WELDING SAFETY AND FIRST AID
UNIT II

SUGGESTED ACTIVITIES

I. Provide student with objective sheet.

II. Provide student with information and assignment sheets.

III. Make transparencies.

IV. Discuss unit and specific objectives.

V. Discuss information and assignment sheets.

VI. Review safety rules that apply to classroom conduct, the proper and authorized use of tools and equipment, school requirements for student insurance, and the reasons for the student safety pledge.

VII. Invite the local fire department to give a fire fighting demonstration and give a fire safety talk. Include a demonstration of proper use of fire extinguishers in the shop and classroom areas.

VIII. Discuss the fire evacuation plan for the classroom and shop, evacuation routes and fire exits, after-emergency assembly points, and procedures for tornado alerts.

IX. Invite a local red cross instructor or another instructor certified to teach first aid to talk to the class about emergency first aid procedures, especially those procedures related to treating cuts, puncture wounds, and burns.

X. Invite a certified first aid instructor to demonstrate the use of pressure points to control bleeding and the use of cardio-pulmonary resuscitation (CPR).

XI. Invite a local or area manufacturer's representative to talk to the class about gas cylinder safety, show a good safety film, and present a demonstration of safe handling of gas cylinders.

XII. Give test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

  A. Objective sheet

  B. Information sheet

  C. Transparency masters

    1. TM 1 — Recommended Eye and Face Protectors

INSTRUCTIONAL MATERIALS

   2. TM 2 — OSHA Poster #2203
   3. TM 3 — Fire Safety
   4. TM 4 — Pressure Points
   5. TM 5 — Standard Student Accident Report Form
   6. TM 6 — Ten Commandments of Welding

D. Assignment sheets

   1. Assignment Sheet #1 — Complete a Student Safety Pledge
   2. Assignment Sheet #2 — Select Proper First Aid Procedures

E. Answers to assignment sheets

F. Test

G. Answers to test

II. References:

A. The American Red Cross, *Standard First Aid and Personal Safety.* Garden City, NY: Doubleday and Co., Inc., 1978.

B. Henderson, John, M.D. *Emergency Medical Guide.* New York, NY: McGraw-Hill, 1963.

C. *Kansas Safety Education Handbook, Volume III.* Wichita, KS: Kansas State Department of Education in Cooperation with the Wichita Public Schools, U.S.D. 259, 1981.

D. *Kidde Portable Extinguishers, The ABC's of Fire Prevention.* Belleville, NJ: Walter Kidde & Co., Inc., 1978.

E. *Electrode Pocket Guide.* Murray Hill, NJ 07974: Airco Welding Products, 1980.

F. *Safety Precautions.* New York, NY 10017: Union Carbide Corporation, Linde Division, 1979.

G. *OSHA Safety and Health Standards (29 CFR 1910), Revised.* Washington, D.C. 20402: U.S. Department of Labor, Occupational Safety and Health Administration, 1981.

WELDING SAFETY AND FIRST AID
UNIT II

INFORMATION SHEET

I. Terms and definitions

   A. Safety — State or condition of being safe; freedom from danger, risk, or injury

   B. Accident — Any suddenly occurring, unintentional event which causes personal injury or property damage

   C. First aid — Immediate, temporary care given the victim of an accident or sudden illness until the service of a physician can be obtained

   D. OSHA — The Occupational Safety and Health Administration; federal legislation designed to insure safe and sanitary working conditions for employees

   E. Pressure points — Points on the body where arteries pass close to the surface of the skin and in front of bone structure so that pressure forcing the artery against the bone can check the flow of blood to a specific part of the body

   F. Combustibles — Materials or liquids that catch fire easily

   G. Hygiene — The science of good health and its maintenance, including sanitary practices and cleanliness

   H. Tetanus — An acute, infectious disease that usually enters the body through cuts or wounds; characterized by spasmodic contractions or rigidity of some voluntary muscles and frequently referred to as lockjaw

   I. Tourniquet — A bandage or strap twisted around a limb to compress the flow of blood through arteries and check severe bleeding; previously a recommended first aid procedure, but now recommended not at all or only in life-threatening situations

   J. Arc burn — A burn on the exterior membrane of the eye caused by exposing the naked eye to the ultra-violet and infra-red rays in the flash of an electric arc or the exposure of improperly covered body areas to the flash of an electric arc

   (CAUTION: Although an arc burn usually causes no permanent eye damage, it produces a painful feeling of having sand in your eyes, and since recovery can take several days, it's good to develop the habit of wearing the correct shade of protective lens when working with any welding process.)

INFORMATION SHEET

II. Safety color codes and their uses

A. Safety green

1. Applied to nonhazardous parts of machine and equipment surfaces, like nameplates and bearing surfaces

2. Designates safe areas of equipment, and is also used to show location of safety equipment and first-aid materials

B. Safety yellow

1. Applied to operating levers, wheels, handles, and hazardous parts that may cause stumbling, falling, snagging, or tripping

2. Designates caution

C. Safety orange

1. Applied to electrical switches, interior surfaces of doors, fuses and electrical power boxes, and movable guards and parts

2. Indicates dangerous parts of equipment which may cut, crush, shock, or otherwise physically injure someone

D. Safety red

1. Applied to buttons or levers of electrical switches used for stopping machinery, and to all equipment, such as gasoline cans, which are fire hazards

2. Designates fire hazards and fire-fighting equipment

(NOTE: The color red is also applied to other fire-fighting equipment, such as fire alarms, fire axes, and emergency exits.)

E. Safety blue

1. Used to identify equipment which is being repaired or is defective and should not be operated

2. Designates "out of order" or "defective"

F. Safety ivory

1. Applied to label edges, vise jaws, and edges of tool rests where extra light reflection is important

2. No particular designation except to help show tool and equipment moving edges more clearly

INFORMATION SHEET

G. Safety black on safety yellow

   1. Applied to area where radiation is a factor or danger

   2. Designates radiation hazards

H. Safety black, safety white, and safety yellow

   1. Applied to floors for safety lanes and location of housekeeping supplies

   2. The single or combination use of these colors are used to identify traffic flow and housekeeping zones

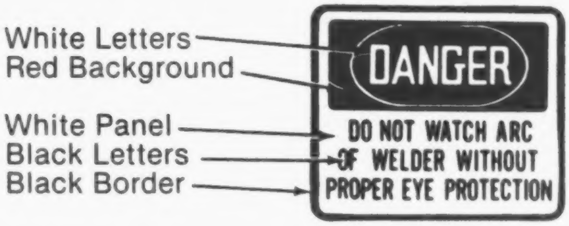
III. Accident prevention signs, their colors and uses

A. Danger Signs

   1. Used where an immediate hazard exists

   2. Colors are red, black, and white (Figure 1)

FIGURE 1

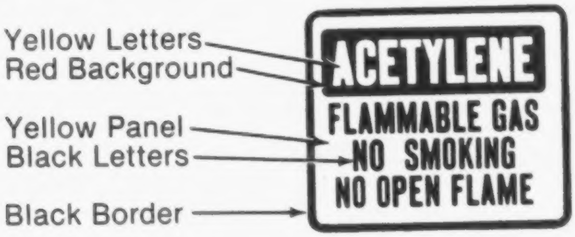

White Letters
Red Background
White Panel
Black Letters
Black Border
DANGER
DO NOT WATCH ARC
OF WELDER WITHOUT
PROPER EYE PROTECTION

B. Caution signs

1. Used to warn against potential hazards or to caution against unsafe practices

2. Colors are yellow and black (Figure 2)

FIGURE 2

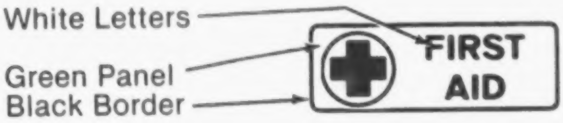

Yellow Letters
Red Background
Yellow Panel
Black Letters
Black Border
ACETYLENE
FLAMMABLE GAS
NO SMOKING
NO OPEN FLAME

C. Safety instruction signs

1. Used where there is a need for general instruction and suggestions relative to safety measures

2. Colors are white, green, and black (Figure 3)

FIGURE 3


White Letters
Green Panel
Black Border
FIRST
AID

IV. Accident prevention tags, their colors and uses

(NOTE: Tags are for temporary use only.)

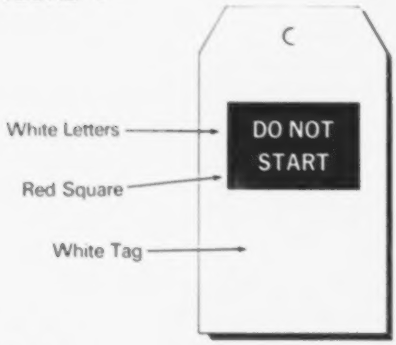
A. Do not start tags

1. Are placed at the starting mechanism which would cause hazardous conditions should the equipment be energized

INFORMATION SHEET

2. Colors are red, white, or gray (Figure 4)

FIGURE 4

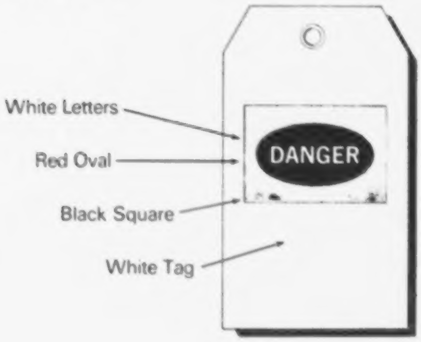

White Letters
Red Square
White Tag
DO NOT
START

B. Danger tags

1. Are placed only where an immediate hazard exists

2. Colors are red, black, and white (Figure 5)

FIGURE 5


White Letters
Red Oval
Black Square
White Tag
DANGER

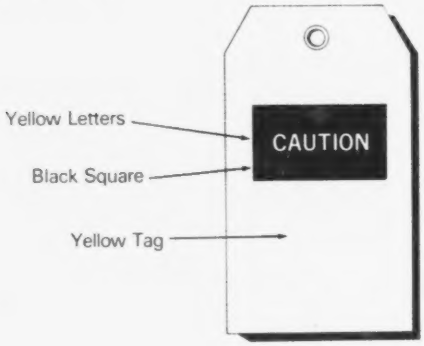
C. Caution tags

1. Are used to warn against potential hazards or to caution against unsafe practices

INFORMATION SHEET

2. Colors are yellow and black (Figure 6)

FIGURE 6

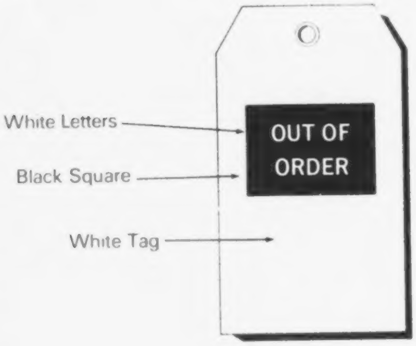

Yellow Letters
CAUTION
Black Square
Yellow Tag

D. Out of order tags

1. Are used to identify pieces of equipment that are out of order

2. Colors are blue and white (Figure 7)

FIGURE 7


White Letters
OUT OF ORDER
Black Square
White Tag

V. The ALWAYS rules for welding safety

A. Always wear suitable protective clothing and eye protection

B. Always keep a safe, clean work area

C. Always keep welding equipment in good condition

D. Always check welding areas to make sure they're safe to work in

INFORMATION SHEET

E. Always respect gas cylinders as dangerous and potentially lethal

F. Always make sure ventilation provides three to four complete changes of air per hour

G. Always look out for fellow students and co-workers

VI. The NEVER rules for welding safety

A. Never enter the welding shop without wearing safety glasses

B. Never weld, cut, or grind near flammable or explosive materials

C. Never use oil on gas cylinders, regulators, connections, or hoses

D. Never permit an electrode holder to come in contact with a welding machine or a gas cylinder

E. Never operate ungrounded equipment

F. Never cut or weld directly on concrete

G. Never arc weld or operate electrically powered equipment while standing on wet or damp floors

H. Never cut into barrels, drums, or any container that has not been purged

I. Never ground electrical equipment to a building member or a piece of equipment attached to or part of a building

J. Never engage in horseplay of any kind

VII. Shop safety rules

A. Keep all hand tools sharp, clean, and in safe working order

B. Report any defective tools, machines, or other equipment to the instructor

C. Keep all guards and safety devices securely in place

D. Operate a hazardous machine only after receiving instruction on how to operate the machine safely

E. Report all accidents to the instructor regardless of nature or severity

F. Turn off the power before leaving a machine tool

INFORMATION SHEET

- G. Make sure all guards and barriers are in place and adjusted properly before starting a machine tool
- H. Disconnect the power from machine tools before performing the maintenance task of oiling or cleaning

VIII. Eye safety (Transparency 1)

- A. Wear safety glasses at all times in the welding shop
- B. Wear safety glasses and a face shield when grinding, chipping, cutting, or shaping metal with any kind of power tool
- C. If you wear contact lenses, check with your doctor to see if the type of lens you wear requires any special precautions in the work environment

  (NOTE: Reports that an electric arc can burn a contact lens to the cornea of the eye are false, but dust or other contaminants in the air can be irritating to persons who wear contact lenses, and some work environments may merit special precautions for contact lens wearers.)
- D. Select proper lens shade for the welding or cutting activity and make sure the lens is not chipped, cracked, or damaged
- E. Do not wear plastic-coated lenses for welding or cutting
- F. Remember that lens shade numbers are not additive, in other words, a #8 and a #6 lens will not give the same density as a #14 lens, so don't mix lenses

INFORMATION SHEET

G. Wear welding goggles or a welding hood with the proper lens shade for all welding and cutting activity

Example:

LENS SHADE SELECTOR

Type of operation	Shade number
Soldering	2
Torch brazing	3 or 4
Oxygen cutting 0 - 1 inch 1 - 6 inches 6 inches and over	 3 or 4 3 or 5 5 or 6
Gas welding 0 - 1/8 inch 1/8 inch to 1/2 1/2 inch and over	 4 or 5 5 or 6 6 or 8
Shielded metal arc welding 1/16, 3/32, 1/8, 5/32 inch electrodes	9 - 14
Arc cutting	12 - 14
Gas metal arc welding	9 - 14
Gas tungsten arc welding Nonferrous, gas metal arc welding 1/16, 3/32, 1/8, 5/32 inch electrodes	9 - 14
Gas tungsten arc welding (ferrous), gas metal arc welding (ferrous) 1/16, 3/32, 1/8, 5/32 inch electrodes	9 - 14

INFORMATION SHEET

IX. Good housekeeping rules

A. Arrange machinery and equipment to permit safe efficient work practices and ease in cleaning

B. Store materials and supplies in proper places

C. Store tools and accessories safely in cabinets, on racks, or other suitable devices

D. Keep working areas and work benches clear and free of debris and other hazards

E. Keep floors clean and free from obstructions and slippery substances

F. Keep aisles, traffic areas, and exits free of materials and other debris

G. Dispose of combustible materials properly or store them in approved containers

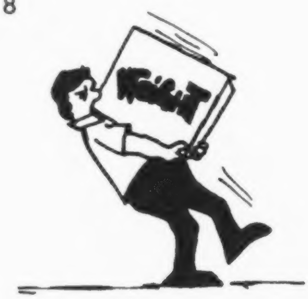
H. Store oily rags in self-closing or spring-lid metal containers

I. Keep sufficient brooms, brushes, and other housekeeping equipment readily available

X. Factors contributing to back injuries and their causes

A. Weight — This usually results from overestimating your physical abilities and trying to lift more weight than you can handle, and sometimes it results from trying to be macho in front of fellow workers (Figure 8)

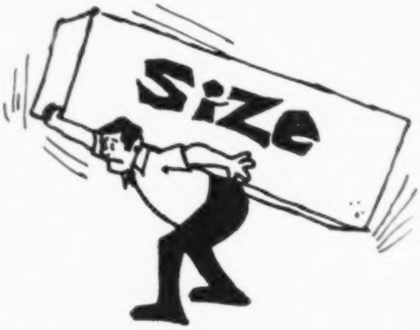
FIGURE 8



INFORMATION SHEET

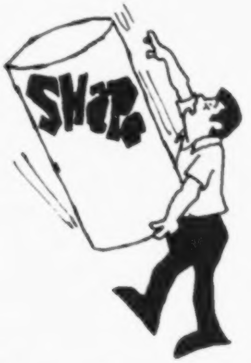
B. Size — This usually results from moving an object that may be within your weight capacity, but too long, high, or wide to lift safely (Figure 9)

FIGURE 9



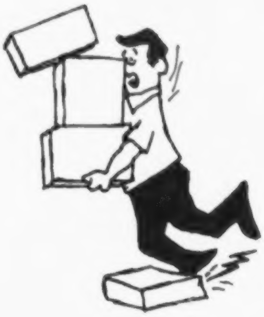
C. Shape — This usually results from moving an object that may be within your weight capacity, but has a cylindrical or other odd shape that makes safe lifting difficult (Figure 10)

FIGURE 10



D. Obstructions — This usually results from stacking materials so high that vision is limited and obstructions in the pathway can't be seen (Figure 11)

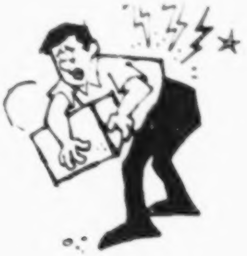
FIGURE 11



INFORMATION SHEET

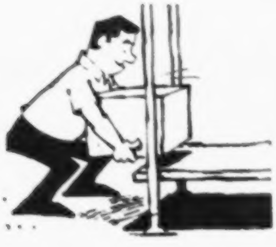
E. Improper position — This usually results from twisting or turning into an awkward position when lifting (Figure 12)

FIGURE 12



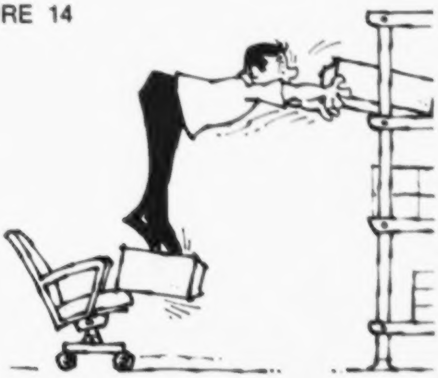
F. Improper storage — This results in strain caused by not storing heavy objects at least 12" off the floor (Figure 13)

FIGURE 13



G. Improper reaching — This usually results from carelessly using chairs or boxes to reach from instead of safely using a ladder (Figure 14)

FIGURE 14

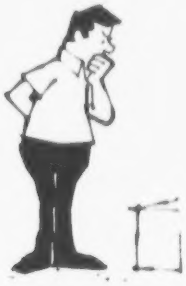


INFORMATION SHEET

XI. Steps in lifting safely

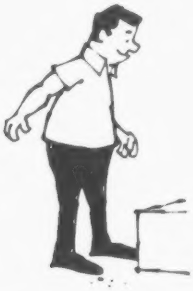
A. Approach the load, size up its weight, size, and shape and consider your physical ability to handle it (Figure 15)

FIGURE 15



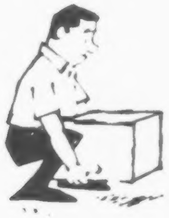
B. Place your feet close to the object to be lifted and keep your feet 8 to 12 inches apart for good balance (Figure 16)

FIGURE 16



C. Bend you knees to the degree that it is comfortable, get a good hand hold, then use both leg and back muscles to begin the lift (Figure 17)

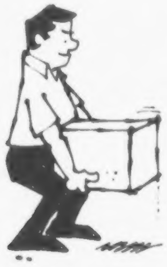
FIGURE 17



INFORMATION SHEET

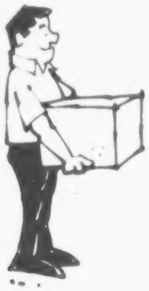
D. Lift the load straight up, smoothly and evenly, while you push with your legs and keep the load as close as possible to your body (Figure 18)

FIGURE 18



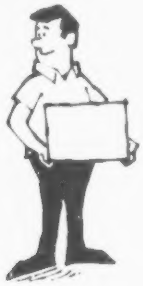
E. Lift the load into carrying position, making no turning or twisting movements until the lift is completed (Figure 19)

FIGURE 19



F. Turn your body with changes of foot position while you visually check your path of travel to make sure it is clear (Figure 20)

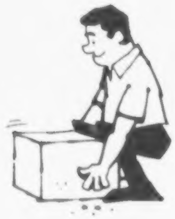
FIGURE 20



INFORMATION SHEET

G. Set the load down by using leg and back muscles together, slowly lower the load by bending your knees, and release your grip only after the load is securely positioned (Figure 21)

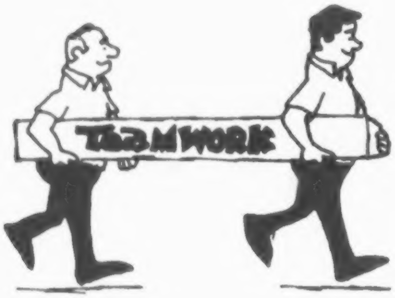
FIGURE 21



H. When lifting or carrying with another worker, make sure the load is equally distributed, and carry long objects at the same level and on the same side of the body (Figure 22)

(NOTE: When moving or carrying large metal sheets, it is especially important to have another worker help.)

FIGURE 22



XII. Things OSHA expects of an employer

A. To provide a hazard-free workplace and comply with occupational safety and health standards

B. To inspect job sites to assure they meet safety standards

C. To use properly color-coded signs to warn of danger

D. To keep required records of work-related injuries and to post an annual summary in February of each year

INFORMATION SHEET

E. To report within 48 hours to OSHA any accident which is fatal or hospitalizes five or more workers

F. To post in a prominent place OSHA poster #2203 informing workers of their rights and responsibilities (Transparency 2)

XIII. Things OSHA expects of an employee

A. Read the OSHA poster #2203 and comply with its standards (Transparency 2)

B. Follow employer safety and health rules and wear prescribed clothing or protective equipment on the job

C. Report hazardous conditions to a supervisor

D. Report all job-related injuries to a supervisor and seek prompt treatment if required

E. Report to OSHA in a responsible manner any hazardous working situations which you feel the employer has not attended to properly

XIV. Rules for personal safety

A. Wear shop clothing appropriate to the instructional activity being performed, and do not wear greasy clothing

B. Confine long hair before operating rotating equipment

C. Remove ties when working around machine tools or rotating equipment

D. Remove rings and other jewelry when working in the shop, and avoid wearing safety glasses that have wire frames

E. Conduct yourself in a manner conducive to safe shop practices

F. Do not smoke in restricted areas and do not carry a butane or propane lighter in your pocket around any welding or cutting activity

XV. Personal physical and hygiene requirements

A. Take a bath or shower daily

(NOTE: This should be a matter of personal pride, a matter of habit, but beyond that, it's a responsibility to your fellow workers or classmates.)

B. Stay in good physical condition because this also promotes good psychological health

INFORMATION SHEET

C. Do not drink alcoholic beverages or use drugs on the job, and don't show up for work with a hangover

(CAUTION: Even at the hangover stage, alcohol impairs judgment and endangers co-workers, and drugs are both physically and psychologically damaging.)

D. Pay attention all the time because the majority of accidents happen to beginners in their first few months of work

XVI. Types of fires and their classifications (Transparency 3)

A. Class A — Fires that occur in ordinary combustible materials

Examples: Wood, rags, paper, or trash

B. Class B — Fires that occur in flammable liquids

Examples: Gasoline, oil, grease, paints, and thinners

C. Class C — Fires that occur in electrical and electronic equipment

Examples: Motors, switchboards, circuit wiring, radios, and television sets

D. Class D — Fires that occur in combustible metals

Example: Powdered aluminum and magnesium

XVII. Types of fire extinguishers and their use (Transparency 3)

A. Water types

1. All water types are used for class A fires only
2. Stored pressure — Operate by squeezing handle or turning valve
3. Cartridge operated — Operate by turning cylinder upside down and bumping
4. Water pump tank — Operate by pumping the handle
5. Soda acid — Operate by turning cylinder upside down

B. Foam type

1. Use for class A or class B fires
2. Operate by turning cylinder upside down

C. Carbon dioxide types (CO_2)

1. Use for class B or class C fires
2. Operate by pulling pin and squeezing lever

D. Dry chemical type

(NOTE: This is a universal type.)

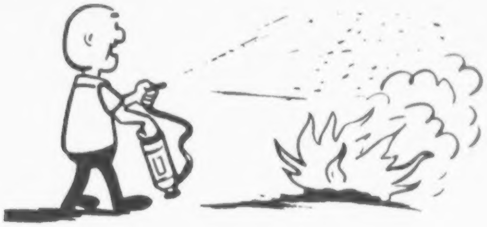
1. Use for class B or class C fires
2. Operate by pulling pin or rupturing cartridge and squeezing lever

   (NOTE: Fire extinguishers are not effective for class D fires. Instead, smother metal fires with dry sand, dirt, salt, or soda ash.)

XVIII. Types of fire extinguishers and their recommended operations

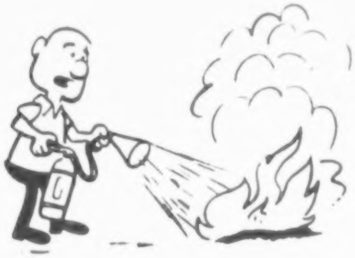
A. Foam — Instead of spraying stream into the burning liquid, allow foam to fall lightly on the fire (Figure 23)

FIGURE 23



B. Carbon dioxide — Direct discharge as close to fire as possible, first at the edge of flames, then gradually forward and upward (Figure 24)

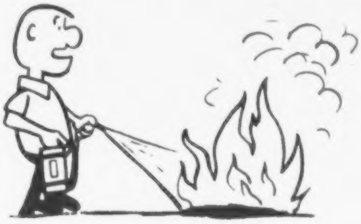
FIGURE 24



INFORMATION SHEET

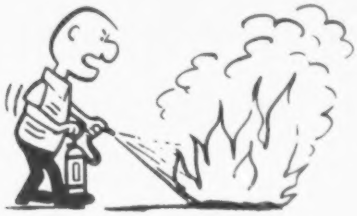
C. Soda acid — Direct stream at base of fire (Figure 25)

FIGURE 25



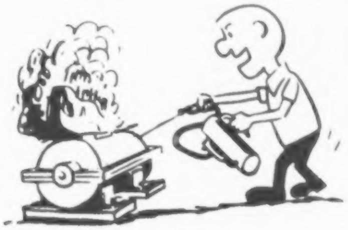
D. Pump tank — Place foot on foot pump and direct stream at base of fire (Figure 26)

FIGURE 26



E. Dry chemical — Direct at the base of the flames and with a class A fire, follow up by directing the dry chemicals at remaining material that is burning (Figure 27)

FIGURE 27



INFORMATION SHEET

XIX. Fire safety rules

A. Report immediately anything that might indicate a potential fire hazard

Example: The sound of wires shorting even though they can't be seen, a light that blinks on and off, and the smell of smoke even when a flame is not visually apparent all indicate potential fire hazards

B. Know the location and the proper operation of fire extinguishers and make sure they have been recently checked

C. Know where the nearest telephone is and make sure the number of the nearest fire department is listed on the phone

D. Know the procedure for evacuating the building and the location of all fire exits in case one or more exits may be blocked

E. Smoke only at authorized times and in authorized areas and make sure cigarette butts are completely extinguished and properly discarded

F. Examine materials and equipment around the workplace to determine what types of fires might occur, then make sure available fire extinguishers are correct for the classes of fires that might occur

G. Isolate combustible materials in fire-resistant areas

H. Dispose of rubbish regularly

I. Conduct fire drills at regular intervals to make sure the alarm can be heard over shop noises, and that everyone knows evacuation routes, exits, and assembly points

(NOTE: During a fire alarm, students should go to an assembly point predetermined by the instructor, and this point should be used to account for all students who have evacuated the building.)

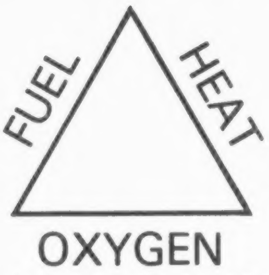
INFORMATION SHEET

XX. Three components of the fire triangle (Figure 28)

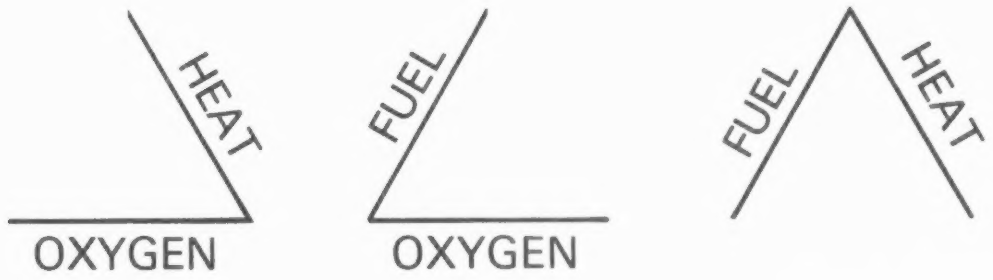
- A. Fuel — Any combustible material
- B. Heat — Enough to raise the fuel to its ignition temperature
- C. Oxygen — Necessary to sustain combustion

FIGURE 28

To produce fire, three things must be present at the same time.


FUEL
HEAT
OXYGEN

If any one of the three is missing, a fire cannot be started or, with the removal of any one, the fire will be extinguished


HEAT
OXYGEN
FUEL
OXYGEN
FUEL
HEAT

INFORMATION SHEET

XXI. Handling and safe storage of gases

A. Oxygen

1. Oxygen is a colorless, odorless, and tasteless gas
2. Oxygen supports and can greatly accelerate combustion
3. Use no oil or grease on any oxygen equipment or fittings
4. Liquid oxygen is extremely cold, so avoid accidental contact with skin

   (NOTE: Liquid oxygen is - 297°F below 0.)
5. Oxygen should not be stored near acetylene cylinders

B. Acetylene

1. Acetylene is a colorless gas with a distinctive garlic-like odor
2. Acetylene mixed with oxygen or air in a confined area will explode if brought into contact with a flame or heat source
3. Acetylene should never be used in excess of 15 psi
4. Acetylene should be stored in a well ventilated area
5. Acetylene gas when combined with oxygen burns at temperatures up to 6,300°F
6. Acetylene should never be used from a cylinder in a horizontal position because this can separate the acetone from other components and create a dangerous situation

C. Argon

1. Argon is a colorless, tasteless, and odorless gas
2. Argon is a nonflammable gas
3. Argon is an inert gas
4. Argon is a cleaning gas when used to weld aluminum
5. Argon gives a smoother arc action during welding
6. Argon should be stored in a well ventilated area because it will displace oxygen in the air

INFORMATION SHEET

D. Carbon dioxide

1. Carbon dioxide is a colorless, tasteless, and odorless gas
2. Carbon dioxide is a very cold gas which can cause severe frostbite to the skin
3. Carbon dioxide can displace the life-giving atmosphere which can cause suffocation, so store in well ventilated area
4. Carbon dioxide is used as a shielding gas in a variety of welding operations

E. Nitrogen

1. Nitrogen is a colorless, tasteless, and odorless gas
2. Nitrogen is an extremely cold gas which can cause severe frostbite to the skin

F. Helium

1. Helium is a tasteless, colorless, odorless gas
2. Helium is an inert welding gas used for shielding
3. Helium should be stored in a well ventilated area

G. Propane

1. Propane is a colorless gas and is a hydrocarbon present in petroleum and natural gas
2. Propane should be stored in a well ventilated area
3. Propane gas when combined with oxygen burns at temperatures up to 5,190°F

H. Mapp (methylacetylene and propadiene)

(NOTE: Mapp is a trade name of the Dow Chemical Company.)

1. Mapp is a colorless gas that has a strong garlic smell
2. Mapp is an acetylene product that is liquified and stabilized so that it can be used at 375 psi at 170°F
3. Mapp gas should be stored in a well ventilated area

INFORMATION SHEET

4. Mapp gas when combined with oxygen burns at temperatures up to 5,301°F

I. Natural gas

1. Natural gas is a tasteless, odorless, and colorless gas
2. Natural gas is a gaseous hydrocarbon which has been distilled
3. Natural gas should be stored in a well ventilated area
4. Natural gas when combined with oxygen burns at temperatures up to 5000°F

XXII. Rules for handling gas cylinders safely

A. Never use a cylinder cap to lift a cylinder

B. Never use oil or grease on a cylinder fitting

C. Never expose a cylinder to excessive heat

D. Never roll a cylinder horizontally across a floor

E. Never tamper with or attempt to repair a cylinder valve, but report it to your instructor immediately

F. Keep caps on cylinders when they are not in use

G. Store all cylinders in well ventilated areas

H. Chain all cylinders in an upright position, even empty ones

I. Do not drop or strike cylinders sharply

J. Do not use a hammer or wrench to force cylinder valves open

K. Keep all cylinders away from electrical contact and any welding arc

L. Close cylinder valves when not in use

M. Never transport cylinders with regulators attached

XXIII. Electrical safety

A. Do not operate electrical equipment without instructions from instructor

B. Do not touch live electrical parts or electrodes with bare skin

INFORMATION SHEET

C. Do not operate electrical parts with wet gloves or wet clothing

(NOTE: To prevent harmful body shocks, keep hands, feet and clothing dry, and use a dry board or rubber mat when water, moisture, or perspiration cannot be avoided.)

D. Never touch an electrode to a grounded surface for these parts will become electrically live

E. Do not operate equipment beyond its rated capacity

F. Know cable loads and do not use welding cable at currents in excess of their capacity

G. Replace worn or bare cables to prevent electrical shock or damage to equipment

(NOTE: Cables can be taped provided the tape has an electrical resistance that is the equal to the original insulation.)

H. Make sure all cable connections are tight, because loose connections could cause overheating of cables and electrical terminals

I. When not in use, never place an electrode holder in contact with a grounded metal surface because it could short circuit the welding machine

J. Machines must be installed according to national and local electrical codes

K. Do not make any adjustment or repairs to any electrical equipment until all power has been disconnected or the electrical breaker has been turned off

(NOTE: Adjustments or repairs should be done only by authorized persons.)

L. Know where all emergency shut down switches are located

M. All electrical equipment and tools should be properly grounded to prevent any injury to the operator

XXIV. First aid for a victim of electrical shock

A. Safely remove the victim from contact with the source of electricity using the following procedure

(CAUTION: Do not touch the electrical circuit or the victim unless the power is off or you are insulated.)

1. Turn off the electricity by means of a switch or circuit breaker or cut cables or wires by means of a wood-handled axe or insulated cutters if available

INFORMATION SHEET

2. Use a dry stick, rope, leather belt, coat, blanket, or any other nonconductor of electricity to separate the victim from the electrical circuit

B. Call for assistance

1. Others in the area may be more knowledgeable than you about treating the victim

2. Another person can call for professional medical help while you administer first aid

C. Check victim's breathing and heartbeat

(NOTE: **TIME IS LIFE AT THIS POINT!**)

1. If pulse is detectable, but breathing has stopped, administer mouth-to-mouth resuscitation until medical help arrives

2. If heartbeat has stopped, administer cardiopulmonary resuscitation, but only if you have been trained in the proper technique

(CAUTION: Cardiopulmonary resuscitation can sometimes cause more harm than good to a victim unless the person administering the first aid has been trained in the proper procedure.)

3. If both heartbeat and breathing have stopped, alternate between cardiopulmonary resuscitation and mouth-to-mouth resuscitation, but again only if you have been trained in this technique

D. Administer first aid for shock and burns as necessary

1. Use blankets or coats to help keep the victim as warm and comfortable as possible while waiting for help

2. Raise victim's legs slightly above head level to help prevent shock

3. If the victim has suffered burns:

a. Cover your mouth and nostrils with gauze or a clean hankerchief to prevent breathing germs on the victim while treating the burns

b. Wrap burned area firmly with sterile gauze or clean linen or towels

(CAUTION: Do not attempt any other treatment of burns.)

E. Always continue treatment but only within your ability until medical help arrives

INFORMATION SHEET

XXV. First aid requirements for common welding injuries

A. Minor cuts

1. Clean with mild soap and water, rinse thoroughly with water, clean again as required
2. Cover with dry sterile dressing
3. Notify supervisor or instructor
4. Always consider tetanus as a potential hazard

B. Puncture wounds

1. Puncture wounds through the skin need prompt medical attention to avoid severe infection
2. Clean with soap and water, rinse thoroughly with water, clean again as required, and cover with a dry sterile dressing
3. Notify supervisor or instructor
4. Always consider tetanus as a potential hazard

C. Slivers and splinters

1. Deep penetration through the skin by slivers and splinters always carries the risk of infection and should be treated as such
2. Do not attempt to remove deeply imbedded splinters, especially where the area appears to be infected
3. Notify supervisor or instructor
4. Always consider tetanus as a potential hazard

D. Thermal burns

1. Give shock treatment to victim immediately
2. Remove clothing from area of burn but do not remove material adhering to burn area
3. Apply thick, dry sterile dressing and bandage snugly to exclude air
4. If sterile dressing is not available, use close-woven, white clean cloth and bandage snugly

INFORMATION SHEET

E. Chemical burns

1. Give shock treatment to victim immediately
2. Immediately wash off chemical with large quantities of running water
3. Cut off clothing from affected area
4. Apply thick dry sterile dressing and bandage snugly to exclude air
5. If sterile dressing is not available, use close-woven, white clean cloths and bandage

XXVI. Ways to recognize shock

A. Skin is pale or bluish

B. Skin may be moist and clammy, even cold to the touch

C. Victim feels weak

D. Pulse is rapid and weak

E. Breathing rate is fast and irregular

F. Victim may be confused or incoherent

XXVII. Steps in treating shock

A. Notify supervisor or instructor IMMEDIATELY

B. DO NOT DELAY immediate first aid treatment; it can be life saving

C. Eliminate the causes of shock, control bleeding, or administer artificial respiration if the victim is not breathing

D. Keep victim lying down with feet slightly elevated

(CAUTION: If the victim has sustained a head or chest injury, do not elevate the feet. Leave the victim lying flat, and when in doubt about the nature of the wound, leave the victim lying flat.)

E. Cover the victim to retain body heat, but do not make the victim sweat

F. Give no liquids or food to victim

INFORMATION SHEET

XXVIII. Steps in controlling bleeding

A. Place a compress of sterile gauze or the cleanest available material directly over the bleeding site

B. Press firmly with fingers or palm of one hand

C. Elevate the bleeding parts above heart level unless there is evidence of a fracture

D. If blood soaks through the first compress, place another compress on it, but do not remove the first compress

E. Secure compress with a pressure bandage

F. Treat for shock

G. If there is a severe life-threatening hemorrhage, AND ONLY AS A LAST RESORT, APPLY A TOURNIQUET

(CAUTION: There is an enormous pressure build-up at the point of tourniquet application. Premature loosening of the tourniquet could cause an excessive loss of blood, and that is why a tourniquet, once applied, should not be loosened except by a physician or on the advice of a physician.)

XXIX. Types of bleeding and their characteristics

A. Arterial bleeding — Characterized by bright-red blood that *spurts* from the wound in sometimes alarming quantity

B. Venous bleeding — Characterized by dark-red blood that *flows* from the wound, sometimes in great quantity

C. Internal bleeding — Characterized by coughing up blood, vomiting blood, or the presence of blood in the victim's stools

XXX. Pressure points for checking bleeding (Transparency 4)

A. Bleeding from the front of the face can often be controlled by pressing the facial artery

B. Bleeding from the armpit, or sometimes the entire arm, can often be controlled by pressure on the subclavian artery

C. Bleeding from an arm can often be controlled by pressure on the brachial artery

INFORMATION SHEET

D. Bleeding from a leg can often be controlled by deep pressure on the femoral artery

(CAUTION: The pressure point selected must be between the heart and the wound. Instruction by a qualified first aid instructor is the best way to learn where pressure points are and how to be sure the right one is selected.)

XXXI. First aid for eye injury

A. Every eye injury should receive immediate first aid attention

B. Notify your supervisor or instructor immediately

C. For an apparent minor object in the eye, have the person wink several times. If the tears produced by winking do not remove the object, assume that the object is embedded and use the following procedure:

1. Have the victim close his or her eyes
2. Put a piece of moist cotton over the closed lid
3. Place a bandage over the cotton
4. Get the victim to a doctor as soon as possible

D. When the eyeball has been obviously scratched or penetrated, apply a sterile dressing, bandage *loosely*, and get medical help immediately

E. Never permit the victim of an eye injury to rub his or her eye

F. When in doubt about any eye injury, seek the most immediate medical attention whether it's on the job or in the classroom

G. Even though damage may be confined to one eye, it is sometimes best to bandage both eyes with a sterile dressing so the victim will not have a tendency to move the damaged eye

H. For chemical or acid splashes, flush the eyes immediately at an eye-flushing station or use a bottled, portable flushing solution, then seek immediate medical assistance

XXXII. General guidelines for first aid emergencies

A. Never hesitate to administer first aid when it is needed

B. Always have a reason for what you do

INFORMATION SHEET

C. Reassure the injured person that everything possible is being done

(NOTE: Hearing the concerned voice of a co-worker is psychologically comforting to an injured person and can actually lessen the degree of shock.)

D. Make accurate notes about the accident including name of victim, time, place, cause or nature of the accident, and any first aid that was administered

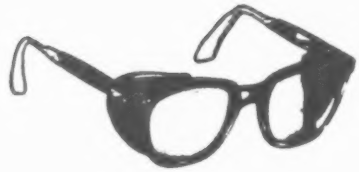
E. Do not notify the victim's family because this is the responsibility of the school, the jobsite supervisor, or the medical facility

F. Report all accidents and injuries to your instructor or jobsite supervisor, no matter how minor they may seem to be

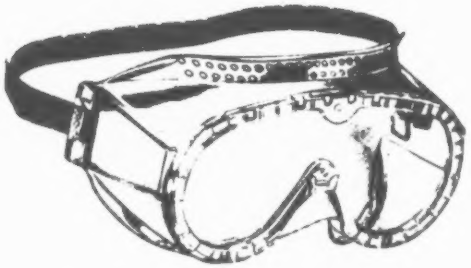
G. File a complete accident report and submit a copy to the proper persons (Transparency 5)

(NOTE: Follow emergency procedures that have been adopted by local school board.)

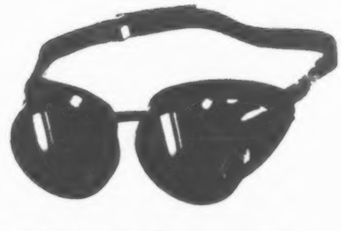
Recommended Eye and Face Protectors



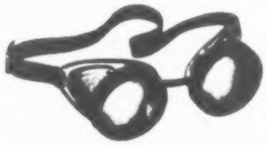
Safety Glasses



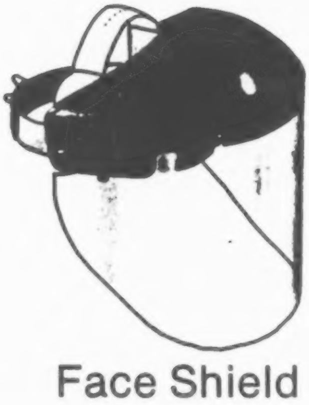
Flexible Goggles



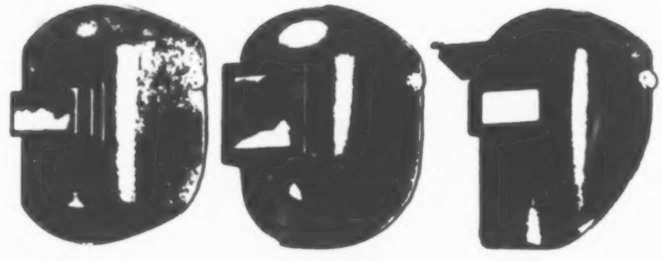
Cutting Goggles



Chipping Goggles



Face Shield



Welding Helments

OSHA Poster #2203

job safety and health protection

The Occupational Safety and Health Act of 1970 provides job safety and health protection for workers through the promotion of safe and healthful working conditions throughout the Nation. Requirements of the Act include the following:

Employers: **Each employer shall furnish to each of his employees employment and a place of employment free from recognized hazards that are causing or are likely to cause death or serious harm to his employees; and shall comply with occupational safety and health standards issued under the Act.**

Employees: **Each employee shall comply with all occupational safety and health standards, rules, regulations and orders issued under the Act that apply to his own actions and conduct on the job.**

The Occupational Safety and Health Administration (OSHA) of the Department of Labor has the primary responsibility for administering the Act. OSHA issues occupational safety and health standards, and its Compliance Safety and Health Officers conduct jobsite inspections to ensure compliance with the Act.

Inspection: The Act requires that a representative of the employer and a representative authorized by the employees be given an opportunity to accompany the OSHA inspector for the purpose of aiding the inspection.

Where there is no authorized employee representative, the OSHA Compliance Officer must consult with a reasonable number of employees concerning safety and health conditions in the workplace.

Complaint: Employees or their representatives have the right to file a complaint with the nearest OSHA office requesting an inspection if they believe unsafe or unhealthful conditions exist in their workplace. OSHA will withhold, on request, names of employees complaining.

The Act provides that employees may not be discharged or discriminated against in any way for filing safety and health complaints or otherwise exercising their rights under the Act.

An employee who believes he has been discriminated against may file a complaint with the nearest OSHA office within 30 days of the alleged discrimination.

Citation: If upon inspection OSHA believes an employer has violated the Act, a citation alleging such violations will be issued to the employer. Each citation will specify a time period within which the alleged violation must be corrected.

The OSHA citation must be prominently displayed at or near the place of alleged violation for three days, or until it is corrected, whichever is later, to warn employees of dangers that may exist there.

Proposed Penalty: The Act provides for mandatory penalties against employers of up to $1,000 for each serious violation and for optional penalties of up to $1,000 for each nonserious violation. Penalties of up to $1,000 per day may be proposed for failure to correct violations within the proposed time period. Also, any employer who willfully or repeatedly violates the Act may be assessed penalties of up to $10,000 for each such violation.

Criminal penalties are also provided for in the Act. Any willful violation resulting in death of an employee, upon conviction, is punishable by a fine of not more than $10,000 or by imprisonment for not more that six months, or by both. Conviction of an employer after a first conviction doubles these maximum penalties.

Voluntary Activity: While providing penalties for violations, the Act also encourages efforts by labor and management, before an OSHA inspection, to reduce injuries and illnesses arising out of employment.

The Department of Labor encourages employers and employees to reduce workplace hazards voluntarily and to develop and improve safety and health programs in all workplaces and industries.

Such cooperative action would initially focus on the identification and elimination of hazards that could cause death, injury, or illness to employees and supervisors. There are many public and private organizations that can provide information and assistance in this effort, if requested.

More Information: **Additional information and copies of the Act, specific OSHA safety and health standards, and other applicable regulations may be obtained from your employer or from the nearest OSHA Regional Office in the following locations:**

Atlanta, Georgia
Boston, Massachusetts
Chicago, Illinois
Dallas, Texas
Denver, Colorado
Kansas City, Missouri
New York, New York
Philadelphia, Pennsylvania
San Francisco, California
Seattle, Washington

Telephone numbers for these offices, and additional Area Office locations, are listed in the telephone directory under the United States Department of Labor in the United States Government listing.

Washington, D.C.
1981
OSHA 2203

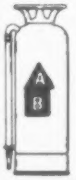
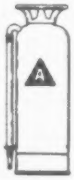
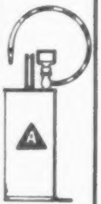
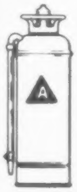
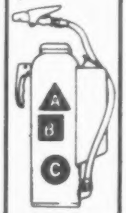
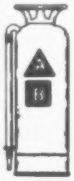
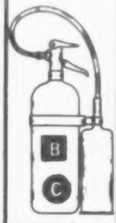
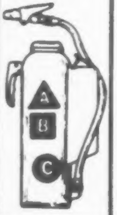
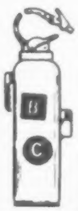
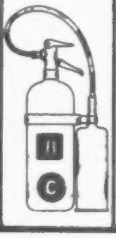
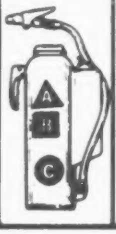
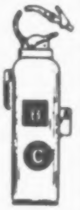
Raymond J. Donovan

Raymond J. Donovan
Secretary of Labor

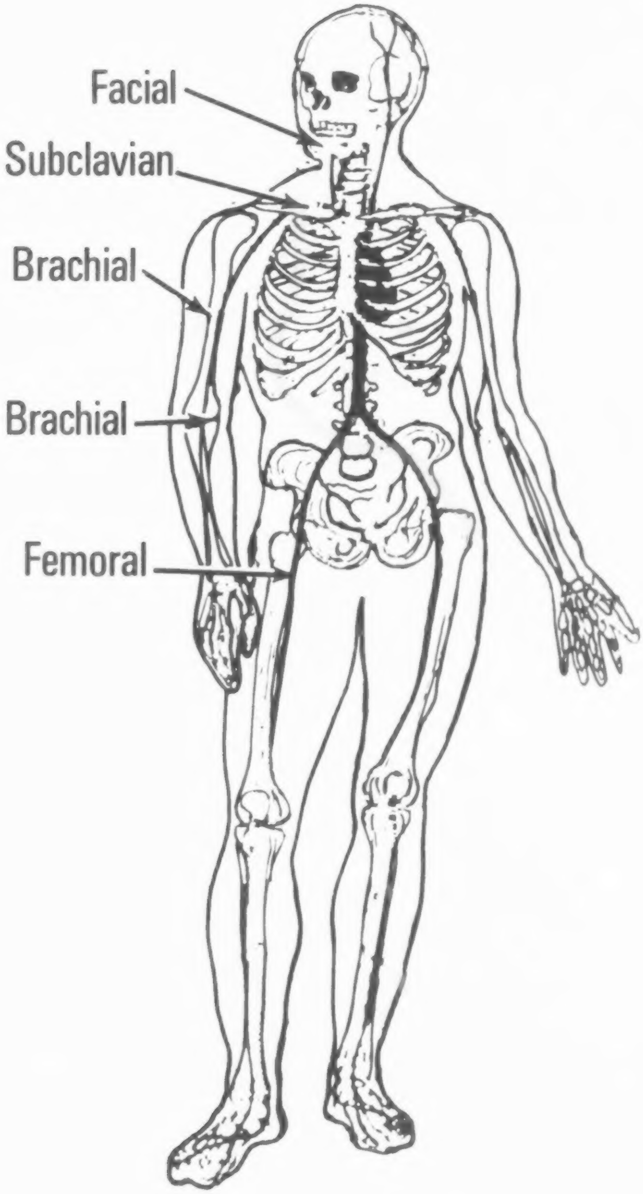
U. S. Department of Labor
Occupational Safety and Health Administration
[illegible]

BEST COPY AVAILABLE

Fire Safety

KIND OF FIRE		APPROVED TYPE OF EXTINGUISHER						
DECIDE THE CLASS OF FIRE YOU ARE FIGHTING. . . ↓	. . .THEN CHECK THE COLUMNS TO THE RIGHT OF THAT CLASS →	MATCH UP PROPER EXTINGUISHER WITH CLASS OF FIRE SHOWN AT LEFT						
		FOAM Solution of Aluminum Sulphate and Bicarbonate of Soda	**CARBON DIOXIDE** Carbon Dioxide Gas Under Pressure	**SODA ACID** Bicarbonate of Soda Solution and Sulphuric Acid	**PUMP TANK** Plain Water	**GAS CARTRIDGE** Water Expelled by Carbon Dioxide Gas	**MULTI-PURPOSE DRY CHEMICAL**	**ORDINARY DRY CHEMICAL**
A 	**CLASS A FIRES** USE THESE EXTINGUISHERS → ORDINARY COMBUSTIBLES • WOOD • PAPER • CLOTH ETC.		X					X
B 	**CLASS B FIRES** USE THESE EXTINGUISHERS → FLAMMABLE LIQUIDS, GREASE • GASOLINE • PAINTS • OILS, ETC.			X	X	X		
C 	**CLASS C FIRES** USE THESE EXTINGUISHERS → ELECTRICAL EQUIPMENT • MOTORS • SWITCHES ETC.	X		X	X	X		

Pressure Points


Facial
Subclavian
Brachial
Brachial
Femoral

Standard Student Accident Form

STANDARD STUDENT ACCIDENT REPORT FORM

Part A. Information on ALL Accidents

1. Name: ____________ Home Address: ____________
2. School: ____________ Sex: M ☐, F ☐ Age ____ Grade or classification: ____
3. Time accident occurred: Hour ____ A.M.; ____ P.M. Date: ____________
4. Place of Accident: School Building ☐ School Grounds ☐ To or from School ☐ Home ☐ Elsewhere ☐

5. **NATURE OF INJURY**

- Abrasion ____
- Amputation ____
- Asphyxiation ____
- Bite ____
- Bruise ____
- Burn ____
- Concussion ____
- Cut ____
- Dislocation ____
- Fracture ____
- Laceration ____
- Poisoning ____
- Puncture ____
- Scalds ____
- Scratches ____
- Shock (el.) ____
- Sprain ____
- Other (specify) ____________

PART OF BODY INJURED

- Abdomen ____
- Ankle ____
- Arm ____
- Back ____
- Chest ____
- Ear ____
- Elbow ____
- Eye ____
- Face ____
- Finger ____
- Foot ____
- Hand ____
- Head ____
- Knee ____
- Leg ____
- Mouth ____
- Nose ____
- Scalp ____
- Tooth ____
- Wrist ____
- Other (specify) ____________

DESCRIPTION OF THE ACCIDENT

How did accident happen? What was student doing? Where was student? List specifically unsafe acts and unsafe conditions existing. Specify any tool, machine or equipment involved. ____________

6. Degree of Injury: Death ☐ Permanent Impairment ☐ Temporary Disability ☐ Nondisabling ☐
7. Total number of days lost from school: ____ (To be filled in when student returns to school)

Part B. Additional Information on School Jurisdiction Accidents

8. Teacher in charge when accident occurred (Enter name): ____________
Present at scene of accident: No: ____ Yes: ____

9. **IMMEDIATE ACTION TAKEN**

First-aid treatment ____ By (Name): ____________
Sent to school nurse ____ By (Name): ____________
Sent home ____ By (Name): ____________
Sent to physician ____ By (Name): ____________
Physician's Name: ____________
Sent to hospital ____ By (Name): ____________
Name of hospital: ____________

10. Was a parent or other individual notified? No ____ Yes: ____ When: ____________ How: ____________
Name of individual notified: ____________
By whom? (Enter name): ____________
11. Witnesses: 1. Name: ____________ Address: ____________
2. Name: ____________ Address: ____________

12. **LOCATION**

	Specify Activity		Specify Activity
Athletic field	____	Locker	____
Auditorium	____	Pool	____
Cafeteria	____	Sch. grounds	____
Classroom	____	____ shop	____
Corridor	____	Showers	____
Dressing room	____	Stairs	____
Gymnasium	____	Toilets and washrooms	____
Home Econ.	____		
Laboratories	____	Other (specify)	____

Remarks

What recommendations do you have for preventing other accidents of this type? ____________

Signed: Principal: ____________ Teacher: ____________

National Safety Council Form School 1
Rev. [illegible]

Printed in U.S.A.

Stock No. 429.21

Ten Commandments of Welding

1. thou shalt not weld on an unpurged tank, for the noise will be very loud when the tank explodes and thy friends will console thy widow in ways generally unacceptable unto thee.

2. thou shalt secure thy tanks, lest one fall on thy foot and transform thee into less than a graceful dancer when called upon by thy wife or other female friend.

3. thou shalt clean thy work carefully, lest thee gaze upon thy work falling apart as it passeth out of thy sight.

4. thou shalt place thy work in jigs, or other holding fixtures for thy eye is a poor instrument for the measurement of angles and great will be the wrath of thy leader as thou art doing thy task a second time.

5. thou shalt not weld near batteries, compressed gasses, or flammable materials lest a spark from thy labors create a fire which would cause thee to continue thy chosen profession in an open field or other such drafty place.

6. thou shalt take great care of thy tools and equipment, lest thy friend who is in charge of such things smites thee about thy head and shoulders for being a wastrel and a knave.

7. thou shalt not perform thy art without proper ventilation, for the smell of toxic gasses produced by the heating of primers, and painted or plated surfaces is worse than a bad cigar and will remain with thee until the end of thy days.

8. thou shalt not weld without goggles, nor shalt thou allow others to gaze upon thy labors, lest thy employment, or the employment of others be changed to sitting on cold and rainy streets while selling pencils.

9. thou shalt wear sturdy gloves, for burns upon thy hands are a source of great pain when thou art attempting to raise thy bowling average.

10. thou shalt ground thy work, when thou weldeth with a machine of arcs, for thou art a poor conductor of electricity and the shock which thou shalt receive shall ruin thy plans for thy weekend.

Courtesy Universal Welding Products

WELDING SAFETY AND FIRST AID
UNIT II

ASSIGNMENT SHEET #1 — COMPLETE A STUDENT SAFETY PLEDGE

STUDENT SAFETY PLEDGE FOR VOCATIONAL WELDING

________________________________, who is enrolled in vocational welding studies at ________________________________, will, as a part of the training program, operate machines and equipment. This activity requires the written permission of parent(s) or guardian.

It is understood that each student will be given proper instruction in the safe use of machines and equipment before being allowed to operate the machines or equipment alone. Further, the student will be instructed in rules and regulations and safety requirements for classroom and shop activities. The student must assume responsibility for conducting himself/herself in a safe manner, and it is requested that the student sign the following student safety pledge:

1. I PROMISE TO ABIDE BY ALL SAFETY RULES FOR THE SHOP AS FOLLOWS:
    a. To use hand tools and power tools only after proper instruction and only with the instructor's permission
    b. To use all tools and equipment only for their intended purposes, and to wear safety glasses at all times in the shop area
    c. To exhibit a concern for tools and equipment by returning them to proper storage areas after use
    d. To contribute to good housekeeping requirements and to keep the shop area clean and safe
    e. To abide by all fire regulations and to respect no smoking signs or areas
    f. To avoid horseplay at all times
    g. To follow all rules and regulations of the school
2. I WILL REPORT ALL ACCIDENTS TO THE INSTRUCTOR IMMEDIATELY

Date ______________________ STUDENT'S SIGNATURE ______________________________

As parent(s) or guardian of ________________________________, I hereby give consent for my son/daughter to operate all machines and equipment necessary for carrying out the requirements of the welding course in which he/she is enrolled (parent or guardian signature not required for students of legal age.)

DATE ______________________

PARENT(S) OR GUARDIAN SIGNATURE ____

(NOTE: Parents are cordially invited to visit the school and inspect the welding program at any convenient time.)

WELDING SAFETY AND FIRST AID
UNIT II

ASSIGNMENT SHEET #2 — SELECT PROPER FIRST AID PROCEDURES

Directions: The following statements present situations in which first aid is required; read the statements carefully and provide answers as indicated.

A. A fellow student has suffered a minor cut working with a piece of metal; you have cleaned the cut with mild soap and water and rinsed the cut off, but the cut still looks as if it might have dirt in it.

1. What would you do next? ______________________________

2. What would you do after that? ______________________________

B. A fellow student complains of a splinter in her wrist; you examine it and find that the splinter is deeply embedded.

1. What would you use to remove the splinter? ______________________________
____

2. What would you do next? ______________________________

C. A fellow student has just had a hard bump on the head; a few moments later he complains of feeling weak; you reach over to help him to a chair and notice that his skin feels moist and almost cold to touch.

1. What is probably wrong? ______________________________

2. What would you do? ______________________________

D. A fellow student has suffered a bad cut; you have cleaned the cut and applied a compress to it, but in a few moments the compress is bloody and messy.

1. Should you remove the blood-soaked compress? ______________________________

2. What would you do next? ______________________________

E. A fellow student has suffered an eye injury, and it appears that a small piece of metal may be embedded in the eyeball.

1. What would you do first? ______________________________

2. What would you do next? ______________________________

ASSIGNMENT SHEET #2

F. A fellow student has suffered an eye injury; nothing appears to be embedded in the eyeball and the rest of the eye appears to be free of any foreign matter, but the student complains of great pain.

1. What should you do if this happens in the school shop? ____________________

   ____

2. What should you do if this happens on the job? ____________________

   ____

G. You have just assisted in administering first aid to a fellow worker with a bad cut; the cut has been cleaned, the compress that was applied is doing a good job, and everything is under control.

1. What should you do next? ____________________

   ____

2. What should you do after that? ____________________

   ____

WELDING SAFETY AND FIRST AID
UNIT II

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #2

A.
1. Clean the cut again
2. Cover with a dry sterile dressing

B.
1. Nothing; deeply embedded splinters should not be removed
2. Notify supervisor or instructor

C.
1. The student is probably suffering from shock
2. Treat for shock

D.
1. No
2. Apply another compress over the first one

E.
1. Apply a sterile dressing
2. Bandage loosely and get medical help immediately

F.
1. Seek the most immediate medical attention
2. Seek the most immediate medical attention

G.
1. Make notes about the accident; name of victim, time, place, cause or nature of the accident, and any first aid that was administered
2. Report the accident to your instructor or supervisor

WELDING SAFETY AND FIRST AID
UNIT II

NAME ______________________

TEST

1. Match the terms on the right with their correct definitions.

_____a. State or condition of being safe; freedom from danger, risk, or injury

_____b. Any suddenly occurring, unintentional event which causes personal injury or property damage

_____c. Immediate, temporary care given the victim of an accident or sudden illness until the service of a physician can be obtained

_____d. The Occupational Safety and Health Administration; federal legislation designed to insure safe and sanitary working conditions for employees

_____e. Points on the body where arteries pass close to the surface of the skin and in front of bone structure so that pressure forcing the artery against the bone can check the flow of blood to a specific part of the body

_____f. Materials or liquids that catch fire easily

_____g. The science of good health and its maintenance, including sanitary practices and cleanliness

_____h. An acute, infectious disease that usually enters the body through cuts or wounds; characterized by spasmodic contractions or rigidity of some voluntary muscles and frequently referred to as lockjaw

1. Tetanus
2. First aid
3. Combustibles
4. Safety
5. Accident
6. Pressure points
7. OSHA
8. Hygiene

______ i. A bandage or strap twisted around a limb to compress the flow of blood through arteries and check severe bleeding; previously a recommended first aid procedure, but now recommended not at all or only in life-threatening situations

______ j. A burn on the exterior membrane of the eye caused by exposing the naked eye to the ultra-violet and infra-red rays in the flash of an electric arc or the exposure of improperly covered body areas to the flash of an electric arc

9. Arc burn
10. Tourniquet

2. Match safety color codes with their uses.

______ a.
1) Applied to nonhazardous parts of machine and equipment surfaces, like nameplates and bearing surfaces
2) Designates safe areas of equipment, and is also used to show location of safety equipment and first-aid materials

______ b.
1) Applied to operating levers, wheels, handles, and hazardous parts that may cause stumbling, falling, snagging, or tripping
2) Designates caution

______ c.
1) Applied to electrical switches, interior surfaces of doors, fuses and electrical power boxes, and movable guards and parts
2) Indicates dangerous parts of equipment which may cut, crush, shock, or otherwise physically injure someone

______ d.
1) Applied to buttons or levers of electrical switches used for stopping machinery, and to all equipment, such as gasoline cans, which are fire hazards
2) Designates fire hazards and fire-fighting equipment

1. Safety blue
2. Safety red
3. Safety ivory
4. Safety orange

TEST

______e. 1) Used to identify equipment which is being repaired or is defective and should not be operated

2) Designates "out of order" or "defective"

______f. 1) Applied to label edges, vise jaws, and edges of tool rests where extra light reflection is important

2) No particular designation except to help show tool and equipment moving edges more clearly

______g. 1) Applied to area where radiation is a factor or danger

2) Designates radiation hazards

______h. 1) Applied to floors for safety lanes and location of housekeeping supplies

2) The single or combination use of these colors are used to identify traffic flow and housekeeping zones

5. Safety yellow
6. Safety green
7. Safety black, safety white, and safety yellow
8. Safety black on safety yellow

3. Match accident prevention signs with their colors and uses.

______a. 1) Used where an immediate hazard exists

2) Colors are red, black, and white

______b. 1) Used to warn against potential hazards or to caution against unsafe practices

2) Colors are yellow and black

______c. 1) Used where there is a need for general instruction and suggestions relative to safety measures

2) Colors are white, green, and black

1. Caution signs
2. Danger signs
3. Safety instruction signs

TEST

4. Match accident prevention tags with their colors and uses.

_____a. 1) Are placed at the starting mechanism which would cause hazardous conditions should the equipment be energized

2) Colors are red, white, or gray

_____b. 1) Are placed only where an immediate hazard exists

2) Colors are red, black, and white

_____c. 1) Are used to warn against potential hazards or to caution against unsafe practices

2) Colors are yellow and black

_____d. 1) Are used to identify pieces of equipment that are out of order

2) Colors are blue and white

1. Caution tags
2. Out of order tags
3. Danger tags
4. Do not start tags

5. Complete statements concerning the ALWAYS rules for welding safety by circling the word(s) that best completes each statement.

a. Always wear suitable protective clothing and (eye protection) (ear plugs)

b. Always keep a safe, (open) (clean) work area

c. Always keep welding equipment in (good condition) (an out-of-the-way place)

d. Always check welding areas to make sure they're (safe to work in) (well lighted)

e. Always respect gas cylinders as (dangerous and potentially lethal) (expensive and easy to damage)

f. Always make sure ventilation provides (one to two) (three to four) complete changes of air per hour

6. Complete statements concerning the NEVER rules for welding safety by circling the word(s) that best completes each statement.

a. Never enter the welding shop without wearing (safety glasses) (helmet and gloves)

b. Never weld, cut, or grind near (fellow worders) (flammable or explosive materials)

TEST

c. Never use (leak detector) (oil) on gas cylinders, regulators, connections, or hoses

d. Never permit (an electrode holder) (bare hands) to come in contact with a welding machine or a gas cylinder

e. Never operate (old) (ungrounded) equipment

f. Never cut or weld directly (on concrete) (against cast iron)

g. Never arc weld or operate electrically powered equipment while standing (on wet or damp floors) (in a poorly lighted area)

h. Never cut into barrels, drums, or any container that has not been (purged) (opened)

i. Never (hang) (ground) electrical equipment to a building member or a piece of equipment attached to or part of a building

j. Never engage in (horseplay of any kind) (unsupervised welding)

7. Select true statements concerning shop safety rules by placing an "X" in the appropriate blanks.

______a. Keep all hand tools sharp, clean, and in safe working order

______b. Report any defective tools, machines, or other equipment to the instructor

______c. Keep all guards and safety devices securely in place

______d. Operate a hazardous machine only after receiving instruction on how to operate the machine safely

______e. Report all accidents to the instructor regardless of nature or severity

______f. Turn off the power before leaving a machine tool

______g. Make sure all guards and barriers are in place and adjusted properly before starting a machine tool

______h. Disconnect the power from machine tools before performing the maintenance task of oiling or cleaning

8. Complete statements concerning eye safety by circling the word(s) that best completes each statement.

a. Wear (safety glasses) (steel-toed shoes) at all times in the welding shop

b. Wear (safety glasses and a face shield) (a face shield) when grinding, chipping, cutting, or shaping metal with any kind of power tool

TEST

c. If you wear (glasses) (contact lenses), check with your doctor to see if the type of lens you wear requires any special precautions in the work environment

d. Select proper lens shade for the welding or cutting activity and make sure the lens is not (chipped, cracked, or damaged) (too dark)

e. Do not wear (amber-colored) (plastic-coated) lenses for welding or cutting

f. Remember that lens shade numbers are not additive, in other words, a #8 and a #6 lens will not give the same density as a #14 lens, (so don't mix lenses) (so mix two darker shades)

g. Wear welding goggles or a welding hood with the proper lens shade for (all welding and cutting activity) (all shop activity)

9. Complete statements concerning good housekeeping rules by inserting the word(s) that best complete each statement.

a. Arrange machinery and equipment to permit safe efficient work practices and ease in ____________

b. Store materials and supplies in ____________ places

c. Store tools and accessories ____________ in cabinets, on racks, or other suitable devices

d. Keep working areas and work benches clear and ____________ ____ ____________ and other hazards

e. Keep floors clean and free from obstructions and ____________ substances

f. Keep aisles, traffic areas, and exits ____________ ____ ____________ and other debris

g. Dispose of ____________ materials properly or store them in approved containers

h. Store ____________ rags in self-closing or spring-lid metal containers

i. Keep sufficient ____________, ____________, and other housekeeping equipment readily available

TEST

10. Match factors contributing to back injuries with their causes.

______a. This usually results from overestimating your physical abilities and trying to lift more weight than you can handle, and sometimes it results from trying to be macho in front of fellow workers

______b. This usually results from moving an object that may be within your weight capacity, but too long, high, or wide to lift safely

______c. This usually results from moving an object that may be within your weight capacity, but has a cylindrical or other odd shape that makes safe lifting difficult

______d. This usually results from stacking materials so high that vision is limited and obstructions in the pathway can't be seen

______e. This usually results from twisting or turning into an awkward position when lifting

______f. This results in strain caused by not storing heavy objects at least 12" off the floor

______g. This usually results from carelessly using chairs or boxes to reach from instead of safely using a ladder

1. Improper storage
2. Weight
3. Obstructions
4. Improper reaching
5. Size
6. Shape
7. Improper position

11. Arrange in order the steps in lifting safely by placing the correct sequence number in the appropriate blank.

______a. Approach the load, size up its weight, size, and shape and consider your physical ability to handle it

______b. Place your feet close to the object to be lifted and keep your feet 8 to 12 inches apart for good balance

______c. Set the load down by using leg and back muscles together, slowly lower the load by bending your knees, and release your grip only after the load is securely positioned

______d. Lift the load into carrying position, making no turning or twisting movements until the lift is completed

TEST

_____e. Bend your knees to the degree that it is comfortable, get a good hand hold, then use both leg and back muscles to begin the lift

_____f. When lifting or carrying with another worker, make sure the load is equally distributed, and carry long objects at the same level and on the same side of the body

_____g. Turn your body with changes of foot position while you visually check your path of travel to make sure it is clear

_____h. Lift the load straight up, smoothly and evenly, while you push with your legs and keep the load as close as possible to your body

12. List two things OSHA expects of an employer.

a. ____

____

b. ____

____

13. List two things OSHA expects of an employee.

a. ____

____

b. ____

____

14. Complete statements concerning rules for personal safety by inserting the word(s) that best complete each statement.

a. Wear shop clothing appropriate to the instructional activity being performed, and do not wear ____________ clothing

b. Confine long hair before operating ____________ equipment

c. Remove ties when working around ____________ ____________ or rotating equipment

d. Remove ____________ and other jewelry when working in the shop, and avoid wearing safety glasses that have wire frames

e. Conduct yourself in a manner conducive to ____________ shop practices

f. Do not smoke in restricted areas and do not carry a ____________ ____ ____________ lighter in your pocket around any welding or cutting activity

TEST

15. Select true statements concerning personal physical and hygiene requirements by placing an "X" in the appropriate blanks.

______a. Take a bath or shower weekly whether you need it or not

______b. Stay in good physical condition because this also promotes good psychological health

______c. Do not drink alcoholic beverages or use drugs on the job, and don't show up for work with a hangover

______d. Pay attention all the time because the majority of accidents happen to beginners in their first few months of work

16. Match types of fires and their classifications.

______a. Fires that occur in ordinary combustible materials

______b. Fires that occur in flammable liquids

______c. Fires that occur in electrical and electronic equipment

______d. Fires that occur in combustible metals

1. Class C
2. Class A
3. Class D
4. Class B

17. Match types of fire extinguishers and their uses.

______a.
1) All these types are used for class A fires only
2) Stored pressure — Operate by squeezing handle or turning valve
3) Cartridge operated — Operate by turning cylinder upside down and bumping
4) Pump tank — Operate by pumping the handle
5) Soda acid — Operate by turning cylinder upside down

______b.
1) Use for class A or class B fires
2) Operate by turning cylinder upside down

1. Foam type
2. Dry chemical type
3. Water types
4. Carbon dioxide types

_____c. 1) Use for class B or class C fires

2) Operate by pulling pin and squeezing lever

_____d. 1) Use for class B or class C fires

2) Operate by pulling pin or rupturing cartridge and squeezing lever

18. Match types of fire extinguishers with their recommended operations.

_____a. Instead of spraying stream into the burning liquid, allow foam to fall lightly on the fire

_____b. Direct discharge as close to fire as possible, first at the edge of flames, then gradually forward and upward

_____c. Direct stream at base of fire

_____d. Place foot on foot pump and direct stream at base of fire

_____e. Direct at the base of the flames and with a class A fire, follow up by directing at remaining material that is burning

1. Carbon dioxide
2. Pump tank
3. Dry chemical
4. Foam
5. Soda acid

19. Select true statements concerning fire safety rules by placing an "X" in the appropriate blanks.

_____a. Report immediately anything that might indicate a potential fire hazard

_____b. Know the location and the proper operation of fire extinguishers and make sure they have been recently checked

_____c. Know where the nearest telephone is and make sure the number of the nearest fire department is listed on the phone

_____d. Know the procedure for evacuating the building and the location of all fire exits in case one or more exits may be blocked

_____e. Smoke only at authorized times and in authorized areas and make sure cigarette butts are completely extinguished and properly discarded

TEST

_____f. Examine materials and equipment around the workplace to determine what types of fires might occur, then make sure available fire extinguishers are correct for the classes of fires that might occur

_____g. Isolate combustible materials in fire-resistant areas

_____h. Dispose of rubbish at least once a month

_____i. Conduct fire drills at regular intervals to make sure the alarm can be heard over shop noises, and that everyone knows evacuation routes, exits, and assembly points

20. Define the three components of the fire triangle.

a. Fuel: ______________________________

b. Heat: ______________________________

c. Oxygen: ______________________________

21. Complete statements concerning handling and safe storage of gases by inserting the word(s) that best completes each statement.

a. Oxygen

1) Oxygen is a colorless, odorless, and __________ gas

2) Oxygen supports and can greatly accelerate ______________

3) Use no __________ ____ __________ on any oxygen equipment or fittings

4) Liquid oxygen is extremely __________, so avoid accidental contact with skin

5) Oxygen should not be stored near __________ cylinders

b. Acetylene

1) Acetylene is a colorless gas with a distinctive ____________ odor

2) Acetylene mixed with oxygen or air in a confined area will ________ ____ if brought into contact with a flame or heat source

3) Acetylene should __________ be used in excess of 15 psi

4) Acetylene should be stored in a well __________ area

TEST

5) Acetylene gas when combined with ______________ burns at temperatures up to 6,300°F

6) Acetylene should never be used from a cylinder in a ______________ position because this can separate the acetone from other components and create a dangerous situation

c. Argon

1) Argon is a colorless, tasteless, and ______________ gas

2) Argon is a ______________ gas

3) Argon is an ______________ gas

4) Argon is a ______________ gas when used to weld aluminum

5) Argon gives a ______________ arc action during welding

6) Argon should be stored in a well ventilated area because it will displace ______________ in the air

d. Carbon dioxide

1) Carbon dioxide is a ______________, tasteless, and odorless gas

2) Carbon dioxide is a very ______________ gas which can cause severe frostbite to the skin

3) Carbon dioxide can displace the life-giving atmosphere which can cause ______________, so store in well ventilated area

4) Carbon dioxide is used as a ______________ ______________ in a variety of welding operations

e. Nitrogen

1) Nitrogen is a colorless, tasteless, and ______________ gas

2) Nitrogen is an extremely cold gas which can cause severe ______________ to the skin

f. Helium

1) Helium is a ______________, colorless, odorless gas

2) Helium is an inert welding gas used for ______________

3) Helium should be stored in a well ______________ area

TEST

g. Propane

1) Propane is a colorless gas and is a ____________ present in petroleum and natural gas

2) Propane should be stored in a well ____________ area

3) Propane gas when combined with ____________ burns at temperatures up to 5,190°F

h. Mapp (methylacetylene and propadiene)

1) Mapp is a colorless gas that has a strong ____________ smell

2) Mapp is an acetylene product that is ____________ and stabilized so that it can be used at 375 psi at 170°F

3) Mapp gas should be stored in a well ____________ area

4) Mapp gas when combined with ____________ burns at temperatures up to 5,301°F

i. Natural gas

1) Natural gas is a tasteless, odorless, and ____________ gas

2) Natural gas is a gaseous ____________ which has been distilled

3) Natural gas should be stored in a well ____________ area

4) Natural gas when combined with ____________ burns at temperatures up to 5000°F

22. Select true statements concerning rules for handling gas cylinders safely by placing an "X" in the appropriate blanks.

_____a. Never use a cylinder cap to lift a cylinder

_____b. Never use oil or grease on a cylinder fitting

_____c. Never expose a cylinder to excessive heat

_____d. Never roll a cylinder horizontally across a floor

_____e. Never tamper with or attempt to repair a cylinder valve, but report it to your instructor immediately

_____f. Keep caps on cylinders when they are not in use

TEST

______g. Store all cylinders in well ventilated areas

______h. Chain all cylinders in an upright position, except for empty ones

______i. Do not drop or strike cylinders sharply

______j. Use a hammer or wrench to force cylinder valves open

______k. Keep all cylinders away from electrical contact and any welding arc

______l. Close cylinder valves when not in use

______m. Transport cylinders with regulators attached when it will save time

23. Complete statements concerning electrical safety by inserting the word(s) that best completes each statement.

    a. Do not operate ____________ equipment without instructions from instructor

    b. Do not touch live electrical parts or ____________ with bare skin

    c. Do not operate electrical parts with ____________ ____________ or ____________ ____________

    d. Never touch an electrode to a ____________ surface for these parts will become electrically live

    e. Do not operate equipment beyond its ____________ ____________

    f. Know cable ____________ and do not use welding cable at currents in excess of their capacity

    g. Replace worn or bare ____________ to prevent electrical shock or damage to equipment

    h. Make sure all cable connections are tight, because loose connections could cause ____________ of cables and electrical terminals

    i. When not in use, never place an electrode holder in contact with a grounded metal surface because it could short circuit the ____________ ____________

    j. Machines must be installed according to ____________ and ____________ electrical codes

    k. Do not make any adjustment or repairs to any electrical equipment until all ____________ has been disconnected or the electrical breaker has been turned off

TEST

l. Know where all ____________ shut down switches are located

m. All electrical equipment and tools should be properly ____________ to prevent any injury to the operator

24. Solve the following problem concerning first aid for a victim of electrical shock:

You hear a shout and turn to see a fellow worker has fallen to the floor with an electrical line under his body. What is the very first thing you should do?

Answer: ____

____

____

25. Select true statements concerning first aid requirements for common welding injuries by placing an "X" in the appropriate blanks.

(NOTE: For a statement to be true, all parts of the statement must be true.)

_____a. Minor cuts

1) Clean with mild soap and water, rinse thoroughly with water, clean again as required

2) Cover with dry sterile dressing

3) Notify supervisor or instructor

4) Always consider tetanus as a potential hazard

_____b. Puncture wounds

1) Puncture wounds through the skin need prompt medical attention to avoid severe infection

2) Clean with soap and water, rinse thoroughly with water, clean again as required, and cover with a dry sterile dressing

3) Notify supervisor or instructor

4) Always consider tetanus as a potential hazard

_____c. Slivers and splinters

1) Deep penetration through the skin by slivers and splinters always carries the risk of infection and should be treated as such

TEST

2) Do not attempt to remove deeply imbedded splinters, especially where the area appears to be infected

3) Notify supervisor or instructor

4) Always consider tetanus as a potential hazard

______d. Thermal burns

1) Give shock treatment to victim immediately

2) Remove clothing from area of burn but [illegible] not remove material adhering to burn area

3) Apply thick, dry sterile dressing and bandage snugly to exclude air

4) If sterile dressing is not available, use close-woven, white clean cloth and bandage snugly

______e. Chemical burns

1) Give shock treatment to victim immediately

2) Immediately wash off chemical with large quantities of running water

3) Cut off clothing from affected area

4) Apply thick dry sterile dressing and bandage snugly to exclude air

5) If sterile dressing is not available, use close-woven, white clean cloths and bandage

26. Complete statements concerning ways to recognize shock by inserting the word(s) that best completes each statement.

a. Skin is pale or ______________

b. Skin may be moist and clammy, even ______________ to the touch

c. Victim feels ______________

d. Pulse is rapid and ______________

e. Breathing rate is fast and ______________

f. Victim may be ______________ or ______________

TEST

27. Arrange in order the steps in treating shock by placing the correct sequence number in the appropriate blank.

______a. DO NOT DELAY immediate first aid treatment; it can be life saving

______b. Cover the victim to retain body heat, but do not make the victim sweat

______c. Keep victim lying down with feet slightly elevated

______d. Eliminate the causes of shock, control bleeding, or administer artificial respiration if the victim is not breathing

______e. Notify supervisor or instructor IMMEDIATELY

______f. Give no liquids or food to victim

28. Arrange in order the steps in controlling bleeding by placing the correct sequence number in the appropriate blank.

______a. If there is a severe life-threatening hemorrhage, AND ONLY AS A LAST RESORT, APPLY A TOURNIQUET

______b. If blood soaks through the first compress, place another compress on it but do not remove the first compress

______c. Place a compress of sterile gauze or the cleanest available material directly over the bleeding site

______d. Treat for shock

______e. Press firmly with fingers or palm of one hand

______f. Secure compress with a pressure bandage

______g. Elevate the bleeding parts above the heart level unless there is evidence of a fracture

29. Match types of bleeding with their characteristics

______a. Characterized by bright-red blood that *spurts* from the wound in sometimes alarming quantity

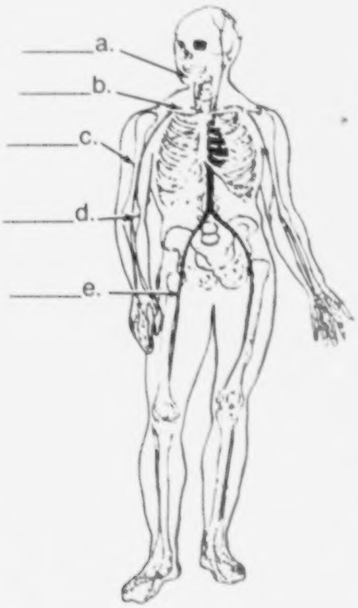
______b. Characterized by dark-red blood that *flows* from the wound, sometimes in great quantity

______c. Characterized by coughing up blood, vomiting blood, or the presence of blood in the victim's stools

1. Venous bleeding
2. Internal bleeding
3. Arterial bleeding

TEST

30. Identify pressure points for checking bleeding by placing the correct number in the appropriate blank.



1. Brachial
2. Brachial
3. Facial
4. Subclavian
5. Femoral

31. Select true statements concerning first aid for eye injuries by placing an "X" in the appropriate blanks.

(NOTE: For a statement to be true, all parts of the statement must be true.)

______a. Every eye injury should receive immediate first aid attention

______b. Notify your supervisor or instructor only after first aid has been administered

______c. For an apparent minor object in the eye, have the person wink several times. If the tears produced by winking do not remove the object, assume that the object is embedded and use the following procedure:

1) Have the victim close his or her eyes

2) Put a piece of moist cotton over the closed lid

3) Place a bandage over the cotton

4) Get the victim to a doctor as soon as possible

TEST

______d. When the eyeball has been obviously scratched or penetrated, apply a sterile dressing, bandage *loosely,* and get medical help immediately

______e. Never permit the victim of an eye injury to rub his or her eye

______f. When in doubt about any eye injury, seek the most immediate medical attention whether it's on the job or in the classroom

______g. Even though damage may be confined to one eye, it is sometimes best to bandage both eyes with a sterile dressing so the victim will not have a tendency to move the damaged eye

______h. For chemical or acid splashes, flush the eyes immediately at an eye-flushing station or use a bottled, portable flushing solution, then seek immediate medical assistance

32. Complete statements concerning general guidelines for first aid emergencies by inserting the word(s) that best completes each statement.

a. Never hesitate to administer first aid when ____ ____ ______________

b. Always ______________ ____ ______________ for what you do

c. ______________ the injured person that everything possible is being done

d. Make ______________ ______________ about the accident including name of victim, time, place, cause or nature of the accident, and any first aid that was administered

e. Do ______________ ______________ the victim's family because this is the responsibility of the school, the jobsite supervisor, or the medical facility

f. Report all accidents and injuries to your instructor or jobsite supervisor, no matter how ______________ they may seem to be

g. File a complete ______________ ______________ and submit a copy to the proper persons

33. Complete a student safety pledge.

34. Select proper first aid procedures.

(NOTE: If these activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

WELDING SAFETY AND FIRST AID
UNIT II

ANSWERS TO TEST

1. a. 4
   b. 5
   c. 2
   d. 7
   e. 6
   f. 3
   g. 8
   h. 1
   i. 10
   j. 9

2. a. 6
   b. 5
   c. 4
   d. 2
   e. 1
   f. 3
   g. 8
   h. 7

3. a. 2
   b. 1
   c. 3

4. a. 4
   b. 3
   c. 1
   d. 2

5. a. Eye protection
   b. Clean
   c. Good condition
   d. Safe to work in
   e. Dangerous and potentially lethal
   f. Three to four

6. a. Safety glasses
   b. Flammable or explosive materials
   c. Oil
   d. An electrode holder
   e. Ungrounded
   f. On concrete
   g. On wet or damp floors
   h. Purged
   i. Ground
   j. Horseplay of any kind

7. All statements are true

8. a. Safety glasses
   b. Safety glasses and a face shield
   c. Contact lenses
   d. Chipped, cracked, or damaged
   e. Plastic-coated

ANSWERS TO TEST

f. So don't mix lenses
g. All welding and cutting activity

9. a. Cleaning
b. Proper
c. Safely
d. Free of debris
e. Slippery
f. Free of materials
g. Combustible
h. Oily
i. Brooms, brushes

10. a. 2
b. 5
c. 6
d. 3
e. 7
f. 1
g. 4

11. a. 1
b. 2
c. 7
d. 5
e. 3
f. 7
g. 6
h. 4

12. Any two of the following:

a. To provide a hazard-free workplace and comply with occupational safety and health standards
b. To inspect job sites to assure they meet safety standards
c. To use properly color-coded signs to warn of danger
d. To keep required records of work-related injuries and to post an annual summary in February of each year
e. To report within 48 hours to OSHA any accident which is fatal or hospitalizes five or more workers
f. To post in a prominent place OSHA poster #2203 informing workers of their rights and responsibilities

13. Any two of the following:

a. Read the OSHA poster #2203 and comply with its standards
b. Follow employer safety and health rules and wear prescribed clothing or protective equipment on the job
c. Report hazardous conditions to a supervisor
d. Report all job-related injuries to a supervisor and seek prompt treatment if required
e. Report to OSHA in a responsible manner any hazardous working situations which you feel the employer has not attended to properly

14. a. Greasy
b. Rotating

ANSWERS TO TEST

c. Machine tools
d. Rings
e. Safe
f. Butane or propane

15. b, c, d

16. a. 2
    b. 4
    c. 1
    d. 3

17. a. 3
    b. 1
    c. 4
    d. 2

18. a. 4
    b. 1
    c. 5
    d. 2
    e. 3

19. a, b, c, d, e, f, g, i

20. a. Any combustible material
    b. Enough to raise the fuel to its ignition point
    c. Necessary to sustain combustion

21. a. 1) Tasteless
       2) Combustion
       3) Oil or grease
       4) Cold
       5) Acetylene

    b. 1) Garlic-like
       2) Explode
       3) Never
       4) Ventilated
       5) Oxygen
       6) Horizontal

    c. 1) Odorless
       2) Nonflammable
       3) Inert
       4) Cleaning
       5) Smoother
       6) Oxygen

ANSWERS TO TEST

- d.
  1) Colorless
  2) Cold
  3) Suffocation
  4) Shielding gas

- e.
  1) Odorless
  2) Frostbite

- f.
  1) Tasteless
  2) Shielding
  3) Ventilated

- g.
  1) Hydrocarbon
  2) Ventilated
  3) Oxygen

- h.
  1) Garlic
  2) Liquified
  3) Ventilated
  4) Oxygen

- i.
  1) Colorless
  2) Hydrocarbon
  3) Ventilated
  4) Oxygen

22. a, b, c, d, e, f, g, i, k, l

23. a. Electrical
    b. Electrodes
    c. Wet gloves, wet clothing
    d. Grounded
    e. Rated capacity
    f. Loads
    g. Cables
    h. Overheating
    i. Welding machine
    j. National, local
    k. Power
    l. Emergency
    m. Grounded

24. Answer should include essential parts of the following:
    a. Safely remove the victim from contact with the source of electricity using the following procedure
    b. Turn off the electricity by means of a switch or circuit breaker or cut cables or wires by means of a wood-handled axe or insulated cutters if available
    c. Use a dry stick, rope, leather belt, coat, blanket, or any other nonconductor of electricity to separate the victim from the electrical circuit

ANSWERS TO TEST

25. All statements are true

26. a. Bluish
    b. Cold
    c. Weak
    d. Weak
    e. Irregular
    f. Confused, incoherent

27. a. 2
    b. 5
    c. 4
    d. 3
    e. 1
    f. 6

28. a. 7
    b. 4
    c. 1
    d. 6
    e. 2
    f. 5
    g. 3

29. a. 3
    b. 1
    c. 2

30. a. 3
    b. 4
    c. 1 or 2
    d. 1 or 2
    e. 5

31. a, c, d, e, f, g, h

32. a. It is needed
    b. Have a reason
    c. Reassure
    d. Accurate notes
    e. Not notify
    f. Minor
    g. Accident report

33. Evaluated to the satisfaction of the instructor

34. Evaluated to the satisfaction of the instructor

WELDING TOOLS AND EQUIPMENT
UNIT III

UNIT OBJECTIVE

After completion of this unit, the student should be able to match basic hand and power tools used in welding with their characteristics and uses. The student should also be able to list basic rules for the safe use and preventive maintenance of hand and power tools and identify basic hand and power tools. This knowledge will be evidenced by correctly performing the procedures outlined in the assignment sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to welding tools and equipment with their definitions.
2. Match driving and chipping tools with their characteristics and uses.
3. Match chisels, punches, and pry bars with their uses.
4. Select true statements concerning files, their uses, basic shapes, and cuts.
5. Complete statements concerning wire brushes, their types and uses.
6. Match holding and anchoring tools with their characteristics and uses.
7. Match alignment tools with their uses.
8. List types of jacks.
9. Match pulling and lifting tools with their characteristics and uses.
10. Match measuring tools with their characteristics and uses.
11. Match turning tools and wrenches with their uses.
12. Match pliers with their uses.
13. Match other manual cutting and shaping tools with their uses.
14. Match power equipment with its characteristics and uses.
15. Match positioning equipment with its characteristics and uses.
16. Complete statements concerning basic rules for safe use of hand tools.

OBJECTIVE SHEET

17. Select true statements concerning basic rules for safe use of power tools and equipment.
18. List the number one rule for maintaining a tool or piece of equipment.
19. Identify basic hand tools.
20. Identify basic power tools and equipment.

WELDING TOOLS AND EQUIPMENT
UNIT III

SUGGESTED ACTIVITIES

I. Provide student with objective sheet.

II. Provide student with information and assignment sheets.

III. Make transparencies.

IV. Discuss unit and specific objectives.

V. Demonstrate the safe and proper use of hand tools as they are presented in the information sheet.

VI. Take students on a tour of the welding shop, demonstrate power tools and equipment, discuss hazards associated with each piece of equipment, and rules for its safe operation.

VII. Invite a manufacturer's representative to give a demonstration of the safe and proper use of selected power equipment.

VIII. Have trade magazines available for students who are interested in furthering their knowledge of new tools and equipment available for welding.

IX. Arrange a field trip to a local or area welding facility where students can see welding positioners, bending and shaping machines, and other power tools used on the job, and have students discuss the tools and machines and their safe operations.

X. Give test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

  A. Objective sheet

  B. Information sheet

  C. Transparency masters

    1. TM 1 — Vise-Grip® Clamps

    2. TM 2 — Platen Table, Tools and Accessories

    3. TM 3 — Types of Jacks

    4. TM 4 — Types of Jacks (Continued)

INSTRUCTIONAL MATERIALS

   5. TM 5 — Types of Calipers
   6. TM 6 — Right and Wrong Use of Tools
   7. TM 7 — Right and Wrong Use of Tools (Continued)

D. Assignment sheets

   1. Assignment Sheet #1—Identify Basic Hand Tools
   2. Assignment Sheet #2—Identify Basic Power Tools and Equipment

E. Test

F. Answers to test

II. References:

A. Jones, Leonard, and Otto Morse. *Sheet Metal Basics*. Stillwater, OK 74074: Mid-America Vocational Curriculum Consortium, 1983.

B. Madsen, Robert J. *Welding Fundamentals*. Alsip, IL 60658: American Technical Publishers, Inc., 1982.

C. Moses, Napoleon W. *Hand Tools for Welding*. Mississippi State, MS 39762: Research and Curriculum Unit for Vocational-Technical Education, College of Education, Mississippi State University, 1982.

WELDING TOOLS AND EQUIPMENT
UNIT III

INFORMATION SHEET

I. Terms and definitions

A. Gauge — The measured thickness of metal or wire or an instrument to measure that thickness

B. Jig — A form or frame used to mass produce a part or to control distortion during a welding process

C. Mechanical shear — A metal-cutting machine with operating power from a clutch or a flywheel that provides high-speed operation

D. Hydraulic shear — A metal-cutting machine with operating power from fluid transport lines to provide a slower rate of operation than a mechanical shear

E. Pneumatic shear — A metal-cutting machine with operating power from compressed air in transport lines to provide a slower rate of operation than a mechanical shear

F. Dies and punches — Extremely hard, precisely shaped metal molds used on a press brake for forming angles and shapes in metal

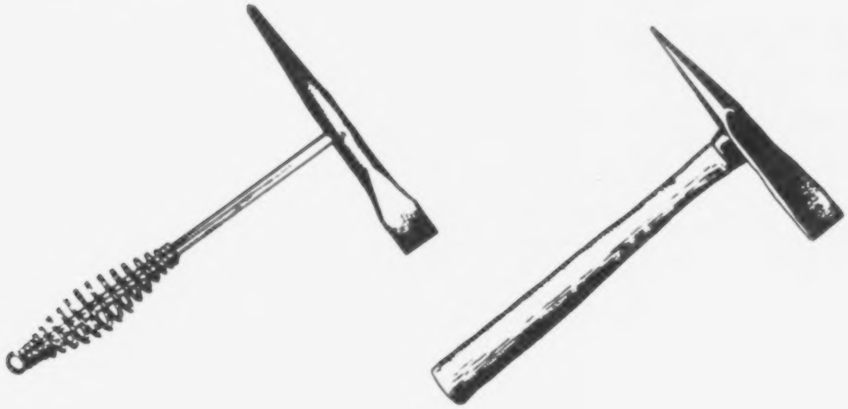
G. Positioners — Platforms or bases designed to secure and manipulate welded products so that welding can usually be accomplished from one position to increase welding speed and weld quality

INFORMATION SHEET

II. Driving and chipping tools, their characteristics and uses

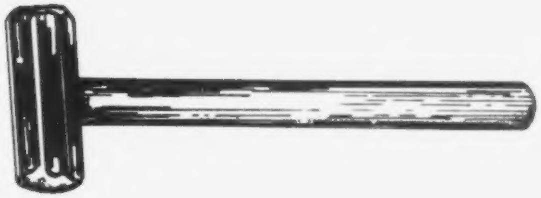
A. Chipping hammer — Used to remove slag and residue left on metals after welding or cutting (Figure 1)

FIGURE 1



B. Fitter's or engineer's hammer — A heavy hammer with two driving heads used to drive wedges under and between materials, and comes in weights of 40, 48, or 64 ounces (Figure 2)

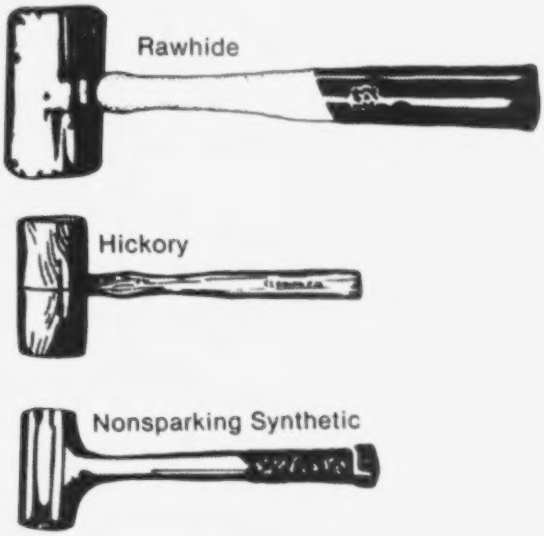
FIGURE 2



INFORMATION SHEET

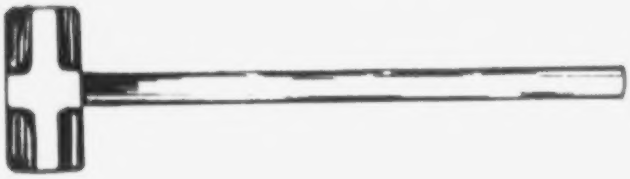
C. Mallets — Used where a metal hammer would dent or damage material, and made of hickory, rawhide, lead, nylon, rubber, or composition materials (Figure 3)

FIGURE 3



D. Sledge hammer — A long-handled hammer used when more driving force is needed than a smaller hammer can deliver, comes in weights from 2 to 20 pounds, and is designed to be used with both hands (Figure 4)

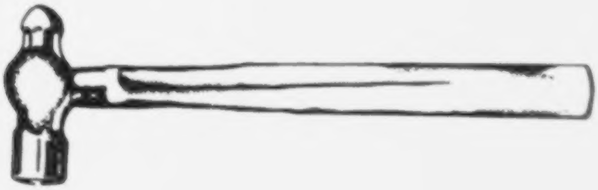
FIGURE 4



INFORMATION SHEET

E. Ball peen hammer — A general purpose hammer with a curved face and a rounded head, comes in weights from 4 to 48 ounces, and is usually used with one hand (Figure 5)

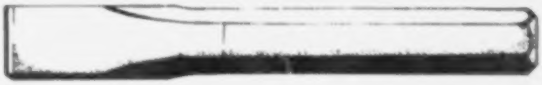
FIGURE 5



III. Chisels, punches, and pry bars and their uses

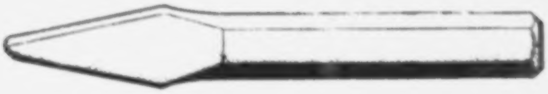
A. Cold chisel — Used for cutting metal, rivets, nuts, and bolts (Figure 6)

FIGURE 6



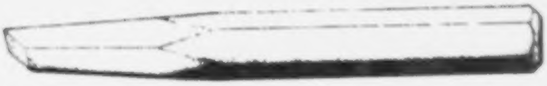
B. Cape chisel — Used for cutting keyways in metal (Figure 7)

FIGURE 7



C. Diamond-point chisel — Used for cutting V-grooves and cleaning out inside corners (Figure 8)

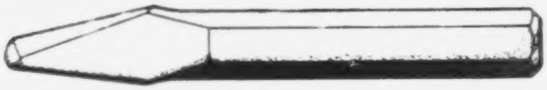
FIGURE 8



INFORMATION SHEET

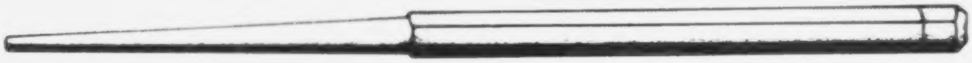
D. Round-nose chisel — Used for cutting U-shaped grooves in metal (Figure 9)

FIGURE 9



E. Drift punch — Used for driving out straight or tapered pins (Figure 10)

FIGURE 10



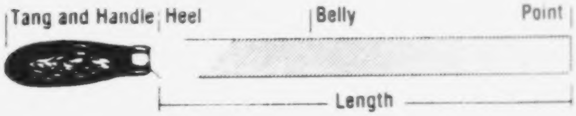
F. Aligning pry bar — Used for prying, positioning, and aligning parts in fit-up (Figure 11)

FIGURE 11

IV. Files, their uses, basic shapes, and cuts

A. Files — Used manually to remove metal stock (Figure 12)

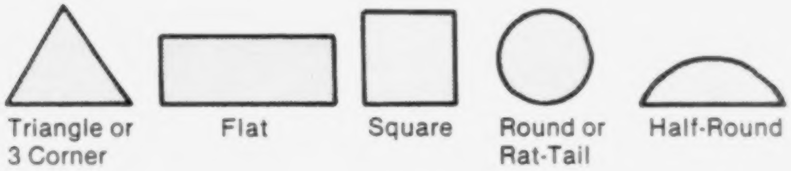
FIGURE 12



INFORMATION SHEET

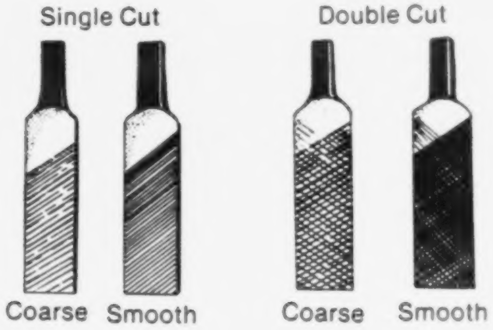
B. Basic shapes of files — Triangular, flat, square, round or rat-tail, and half round to provide a shape to match the job need (Figure 13)

FIGURE 13


Triangle or 3 Corner
Flat
Square
Round or Rat-Tail
Half-Round

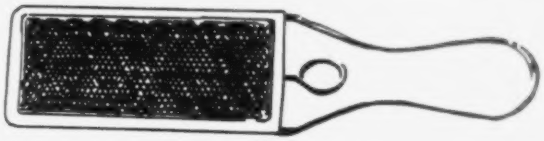
C. Basic file cuts — From single-cut coarse to double-cut smooth to provide textures that produce specific finishes (Figure 14)

FIGURE 14


Single Cut
Double Cut
Coarse
Smooth
Coarse
Smooth

D. Card file — Used to clean file (Figure 15)

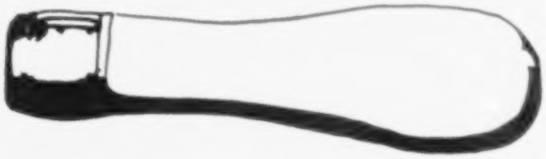
FIGURE 15



INFORMATION SHEET

E. File handle — Used to cover the tang of a file and protect against injury, and a file must not be used without a handle (Figure 16)

FIGURE 16

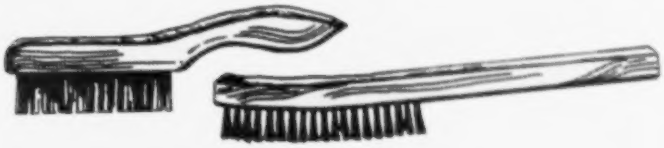


V. Wire brushes, their types and uses

A. Uses — For cleaning a weld area before or after welding

B. Types — Steel wire bristles or stainless steel bristles with shoe handles or bent handles (Figure 17)

FIGURE 17



VI. Holding and anchoring tools, their characteristics and uses

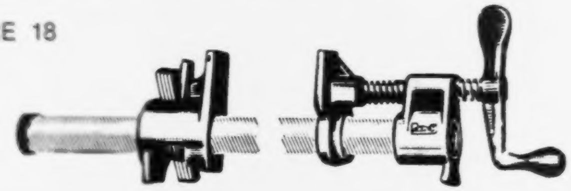
A. Vise-grip® clamps — Plier-type devices used to hold materials until they can be tacked in place, adjustable to almost any metal gauge, and handy to work with because they go on and come off quickly (Transparency 1)

1. Curved jaw
2. Straight jaw
3. C-clamp
4. Long-reach C-clamp
5. Welding clamp
6. Sheet metal
7. Chain clamp

INFORMATION SHEET

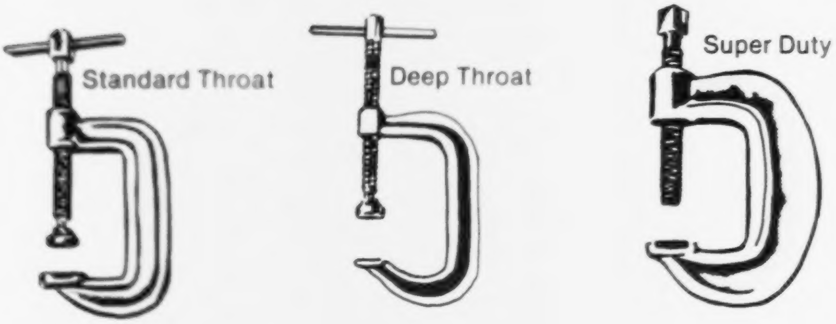
B. Bar clamps — Adjustable vise-like devices used to hold materials together until they can be joined by other means, and will hold longer and wider materials than a vise can (Figure 18)

FIGURE 18



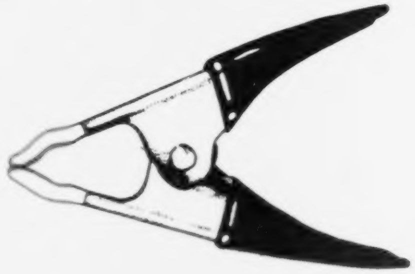
C. C-clamps — Used to hold two or more pieces of material together until they can be tacked or joined together by other means (Figure 19)

FIGURE 19



D. Spring clamps — Used to secure a tape line to the end of a piece of material or to secure light detail material onto main members (Figure 20)

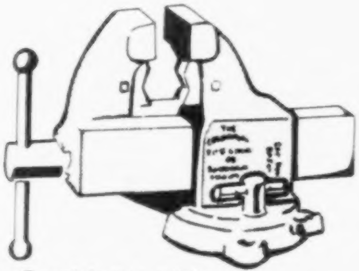
FIGURE 20



INFORMATION SHEET

E. Vises — Used to secure workpieces that cannot or should not be held by hand, usually fastened to a work bench, and have opposing jaws adjustable with a screw-type movement (Figure 21)

FIGURE 21



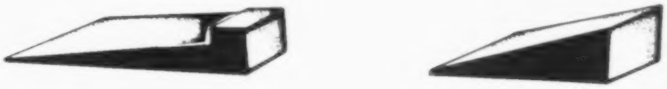
Combination/Pipe

F. Platen table — Used to eliminate welding and bending jigs and has special accessories used in layout and various other welding activities (Transparency 2)

VII. Alignment tools and their uses

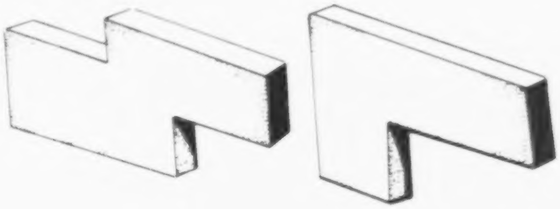
A. Wedges — Used to fit-up two or more pieces of material by inserting a V-shaped end in between pieces and striking the head or opposite end with a hammer to obtain vertical or horizontal alignment (Figure 22)

FIGURE 22



B. Clip plates or dogs — Used as a restraining device so that wedges can be applied and driven (Figure 23)

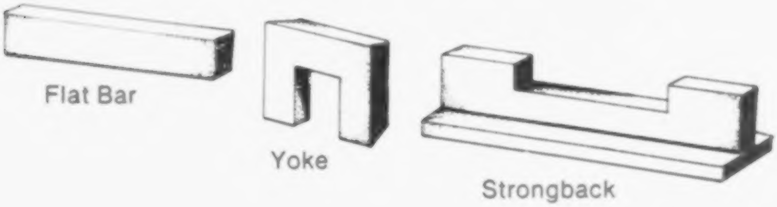
FIGURE 23



INFORMATION SHEET

C. Flat bar, yoke, and strongback — Used as restraining devices so that wedges can be applied and driven in situations where clip plates or dogs would not provide enough strength (Figure 24)

FIGURE 24



VIII. Jacks, their uses and types

A. Used for exerting pressure and lifting or lowering heavy objects short distances

B. Types of jacks (Transparencies 3 and 4)

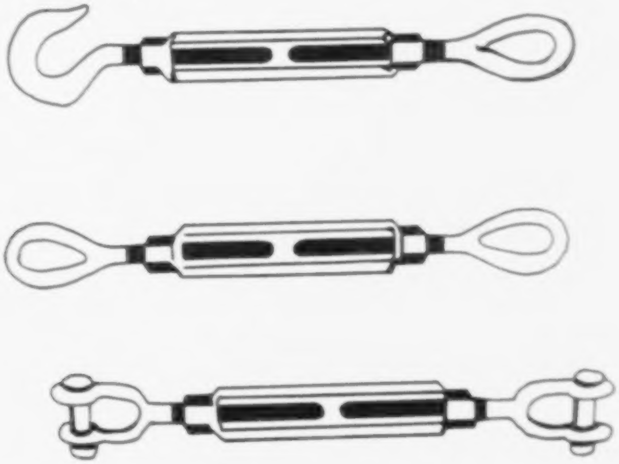
1. Ratchet level jack (railroad jack)
2. Journal jack (bottle jack or booby jack)
3. Hydraulic jack with external pump
4. Push-pull jack (steamboat jack)
5. Self-contained hydraulic jack
6. Wedge jack
7. Screw jack

INFORMATION SHEET

IX. Pulling and lifting tools, their characteristics and uses

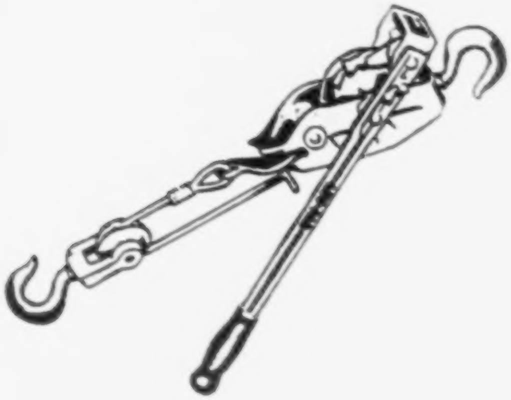
A. Turnbuckles — Used to adjust lengths of wire rope or steel rod, and are adjustable for taking up slack and inducing a load or being slacked off to reduce a load (Figure 25)

FIGURE 25



B. Come-alongs — Used as manually operated hoists, are portable, easy to set-up, and may be constructed with chain or cable (Figure 26)

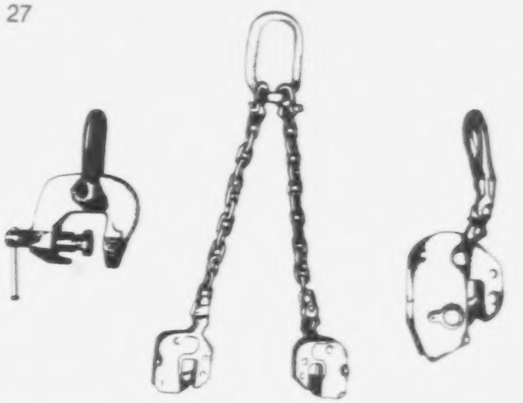
FIGURE 26



INFORMATION SHEET

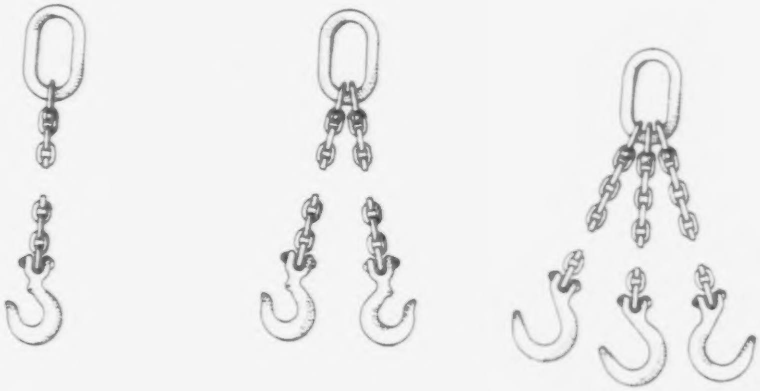
C. Plate dogs — Used to lift plates safely and move them from one place to another (Figure 27)

FIGURE 27



D. Slings — Cables and hooks or chains and hooks used in single, double, triple, or quadruple arrangement for lifting and moving heavy objects (Figure 28)

FIGURE 28

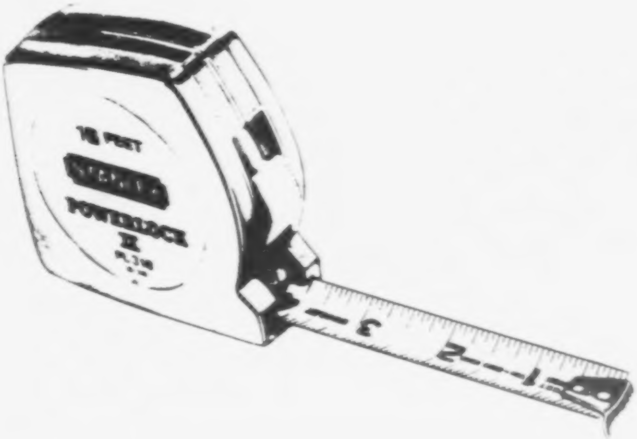


INFORMATION SHEET

X. Measuring tools, their characteristics and uses

A. Pocket tape — Used to measure gauges, set lines, holes, and work points and many other straight line measurements up to 25′, and is often used by fitters so it is made to be carried on a welder's belt (Figure 29)

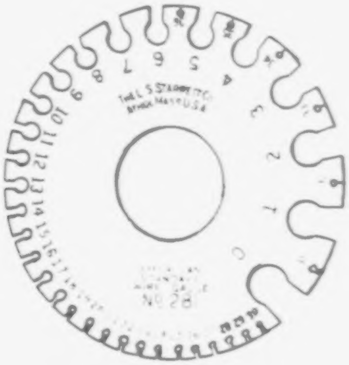
FIGURE 29



POWERLOCK
II

B. American and U.S. standard metal gauges — Used to measure the thickness or gauge of sheet metal, plate, and wire (Figure 30)

FIGURE 30



THE L.S. STARRETT CO.
ATHOL MASS U.S.A.
0
1
2
3
4
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6
7
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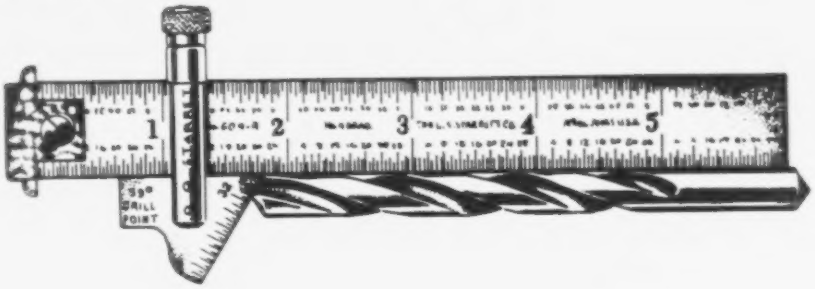
11
12
13
14
15

INFORMATION SHEET

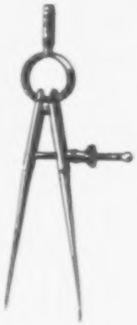
C. Drill point gauge — Used to assure that drill tips being sharpened are kept centered at an angle of 59° so that they will cut faster with less applied force (Figure 31)

FIGURE 31



D. Wing dividers — Used to construct small circles and arcs and transfer measurements (Figure 32)

FIGURE 32



E. Calipers — Used for inside and outside measurements (Transparency 5)

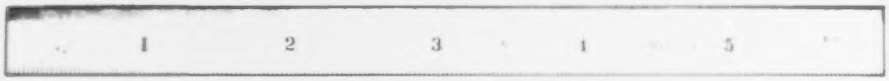
1. Inside caliper
2. Outside caliper
3. Hermaphrodite caliper
4. Slide caliper rule
5. Dial caliper

INFORMATION SHEET

F. Rules — Measuring devices graduated in whole units and fractions and used in measuring distances ranging from fractions of an inch up to 48 inches

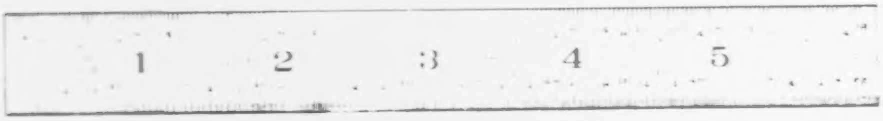
1. Narrow flexible rule (Figure 33)

FIGURE 33



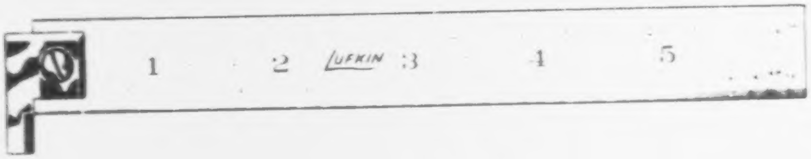
2. Steel rule (Figure 34)

FIGURE 34



3. Hook rule (Figure 35)

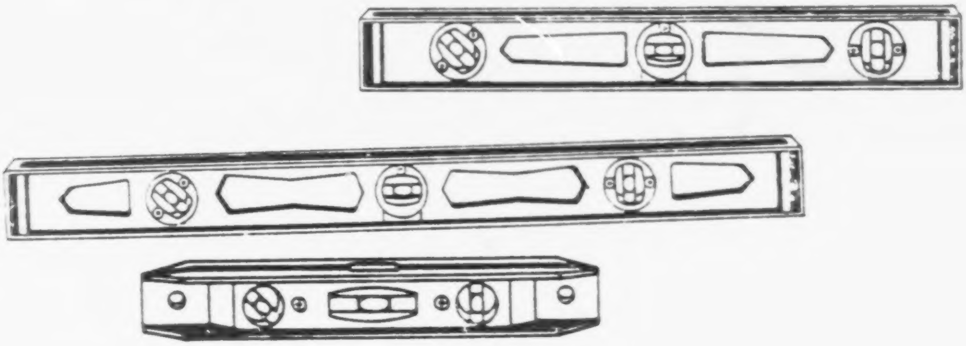
FIGURE 35



INFORMATION SHEET

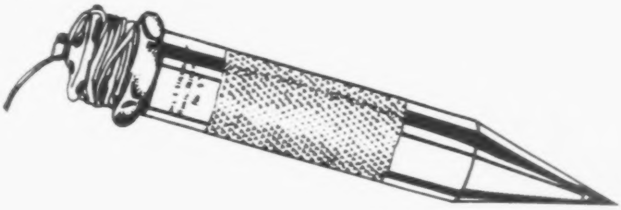
G. Levels — Devices used to check surfaces for true alignment horizontally, vertically, or at a 45° angle (Figure 36)

FIGURE 36



H. Plumb bob — Used to check related members for alignment or plumb, cord or string length varies, and common weights range from 6 ounces to 24 ounces (Figure 37)

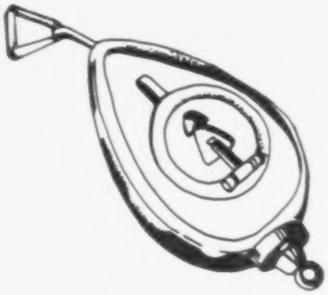
FIGURE 37



INFORMATION SHEET

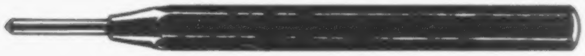
I. Chalk line — Chalk-coated line stretched tightly and snapped sharply to mark a straight line between two points, and can also be used to check for straightness in plate and structural metals (Figure 38)

FIGURE 38



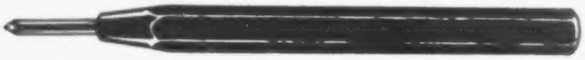
J. Center punch — Used to make puncture marks, to locate centers of holes, or establish work points or center lines on materials (Figure 39)

FIGURE 39



K. Prick punch — Used most often to make punch marks along layout lines to provide permanent references for chalked or scribed lines that might wear off in handling (Figure 40)

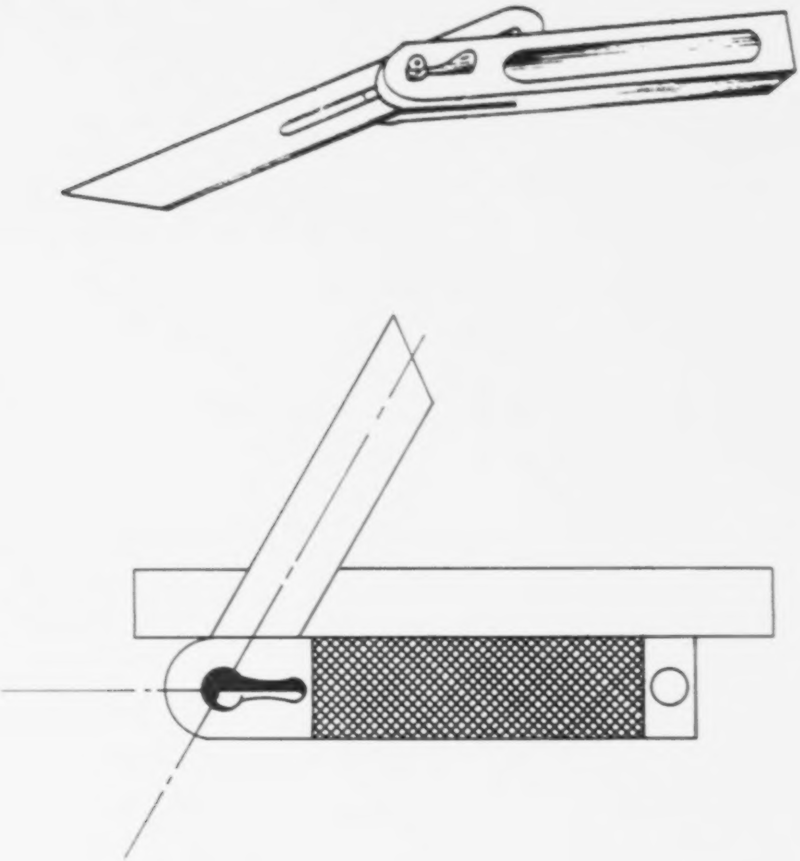
FIGURE 40



INFORMATION SHEET

L. Bevel square — Used to lay out bevel lines or check materials cut on a bevel, and can be adjusted to all angles (Figure 41)

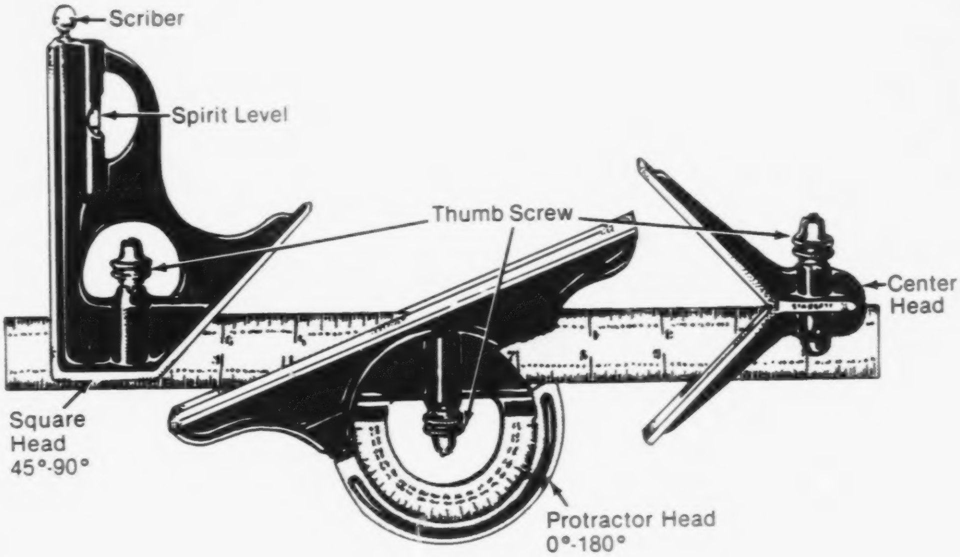
FIGURE 41



INFORMATION SHEET

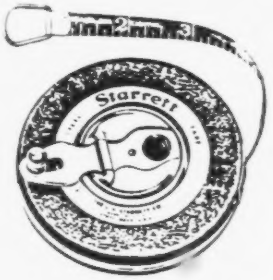
M. Combination square — Used to square detail material, square head is used for 45° and 90° angles, protractor head is used to read angles from 0° to 180°, and center head is used to find the center of round materials (Figure 42)

FIGURE 42


Scriber
Spirit Level
Thumb Screw
Center Head
Square Head 45°-90°
Protractor Head 0°-180°

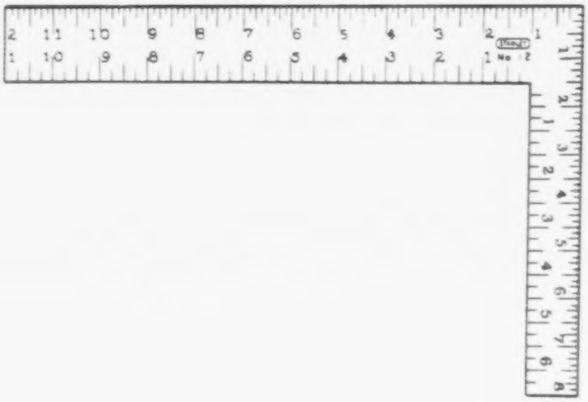
N. Steel tapes — Used to measure distances between points, used for layout work and for squaring, and generally longer than 25′ (Figure 43)

FIGURE 43



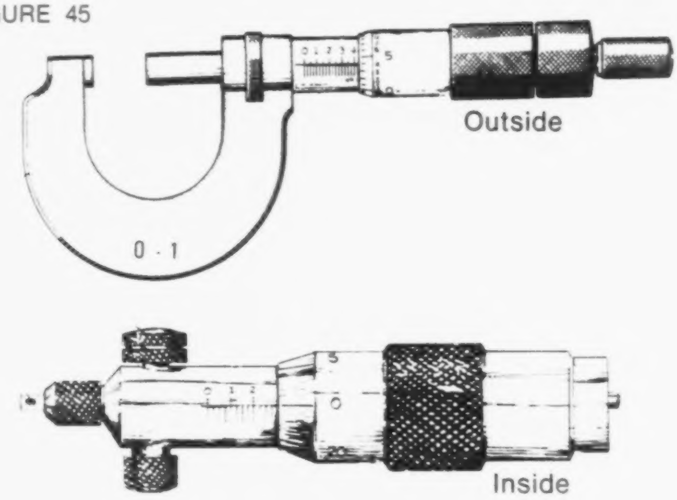
O. Framing square — Used primarily by fitters to check trueness of flanges and angles, used for setting and checking bevel squares, and edges marked with rule-like graduations make it a good measuring tool (Figure 44)

FIGURE 44



P. Micrometers — Used to measure inside, outside, or depth of parts that require critical tolerances (Figure 45)

FIGURE 45

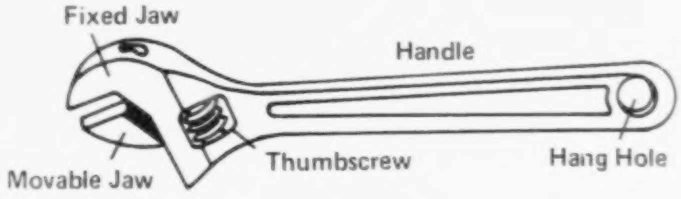


INFORMATION SHEET

XI. Turning tools and wrenches and their uses

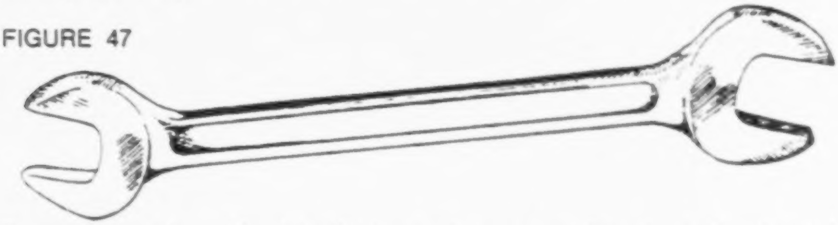
A. Adjustable wrench (crescent wrench) — Used to tighten or loosen different sizes of nuts and bolts (Figure 46)

FIGURE 46



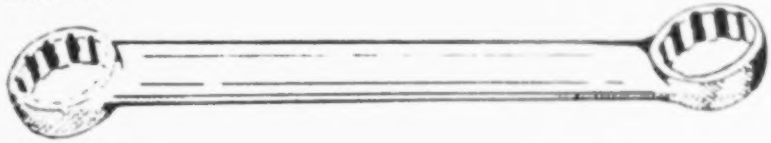
B. Open-end wrench — Used to tighten or loosen specific sizes of nuts and bolts (Figure 47)

FIGURE 47



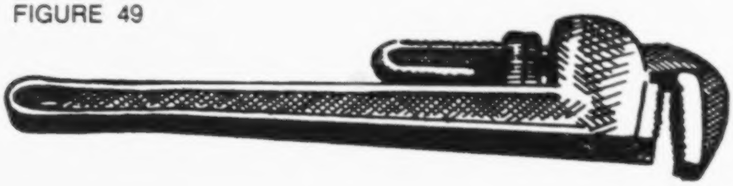
C. Box-end wrench — Used to tighten or loosen specific sizes of nuts and bolts (Figure 48)

FIGURE 48



D. Pipe wrench — Used primarily for fitting up pipe, but handy for holding and aligning because of its vise-like adjustable jaws (Figure 49)

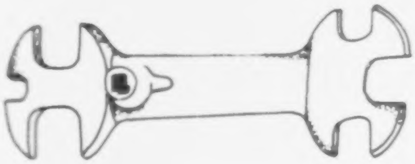
FIGURE 49



INFORMATION SHEET

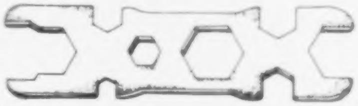
E. Cylinder wrenches — Used specifically for tightening or loosening cylinder connections on oxyacetylene equipment because adjustable wrenches can easily damage the brass fittings used on oxyacetylene equipment (Figure 50)

FIGURE 50



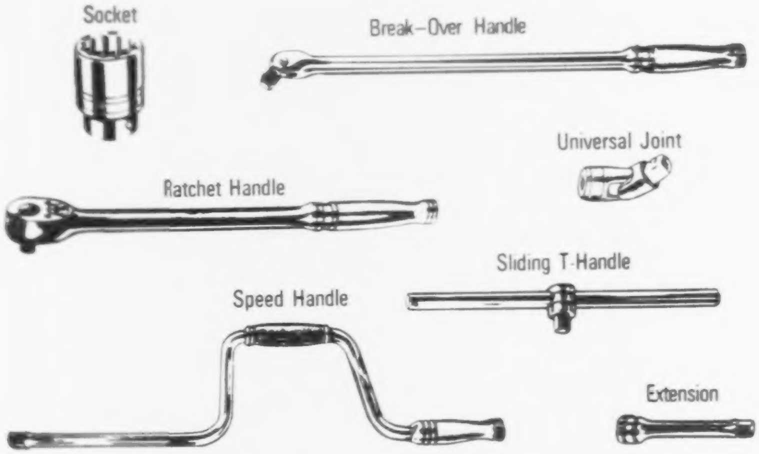
F. Torch wrenches — Used specifically for tightening or loosening torch connections where the use of adjustable wrenches or pliers might damage brass fittings (Figure 51)

FIGURE 51



G. Socket wrench and handles — Used to tighten or loosen specific sizes of nuts and bolts with a variety of socket sizes and handles for various jobs (Figure 52)

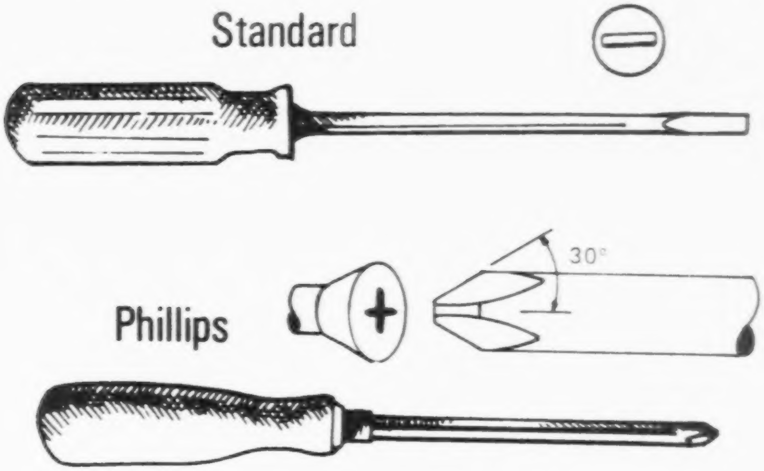
FIGURE 52


Socket
Break-Over Handle
Universal Joint
Ratchet Handle
Sliding T-Handle
Speed Handle
Extension

INFORMATION SHEET

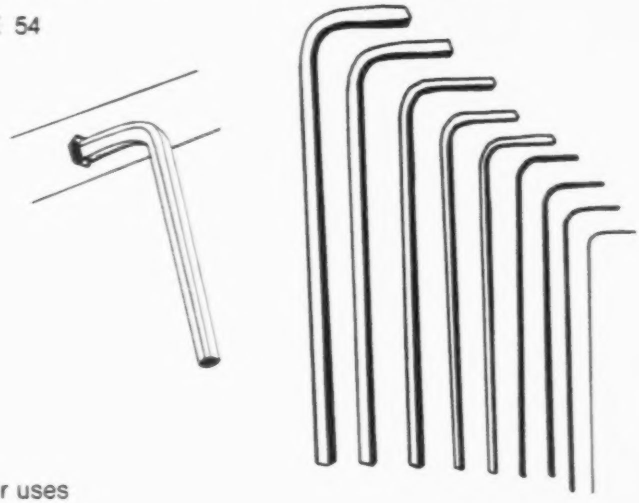
H. Screwdrivers — Used to tighten or loosen specific types of screws, bolts, and other anchoring devices (Figure 53)

FIGURE 53



I. Allen wrenches — Hex-shaped key-type wrenches used to tighten or loosen specific sizes of Allen screws or bolts (Figure 54)

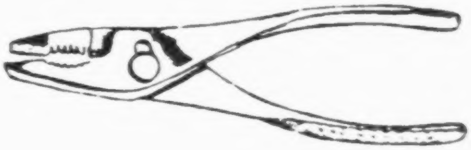
FIGURE 54



XII. Pliers and their uses

A. Slip joint — Used for handling hot metal or materials (Figure 55)

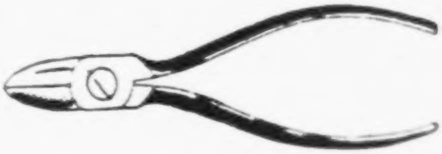
FIGURE 55



INFORMATION SHEET

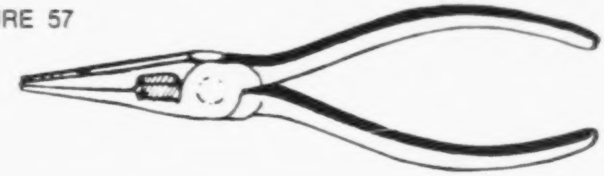
B. Diagonal cutters — Used for cutting small diameter wire, and frequently used in GMAW welding (Figure 56)

FIGURE 56



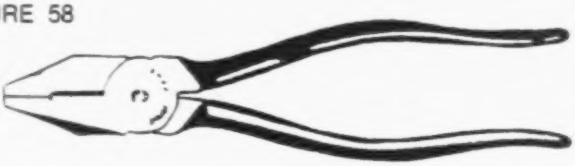
C. Needle nose — Used for cleaning cups and nozzles, cutting small diameter wire, holding, and bonding, and used mostly in GMAW welding (Figure 57)

FIGURE 57



D. Lineman's (side cutters) — Used to cut larger diameter wire, holding, and is used in submerged arc welding (Figure 58)

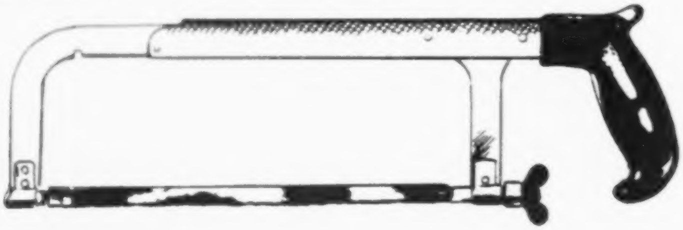
FIGURE 58



XIII. Other manual cutting and shaping tools and their uses

A. Hacksaw — Used to manually cut or separate metal (Figure 59)

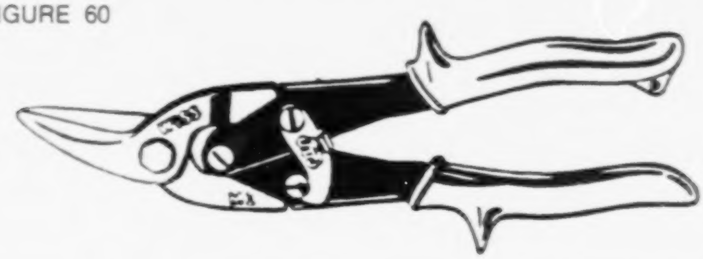
FIGURE 59



INFORMATION SHEET

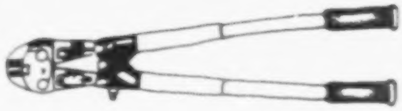
B. Straight-cut snips — Used to cut straight lines or curves on light-gauge metal and also available in left or right cuts (Figure 60)

FIGURE 60



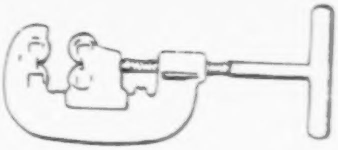
C. Bolt cutters — Used to cut small diameter nuts, bolts, rod, and chain (Figure 61)

FIGURE 61



D. Pipe cutters — Used for cutting small-diameter pipe or tubing (Figure 62)

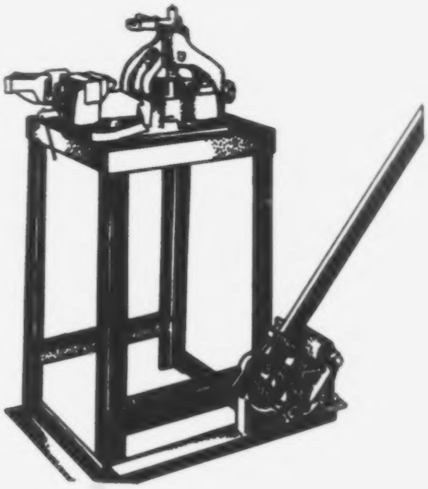
FIGURE 62



INFORMATION SHEET

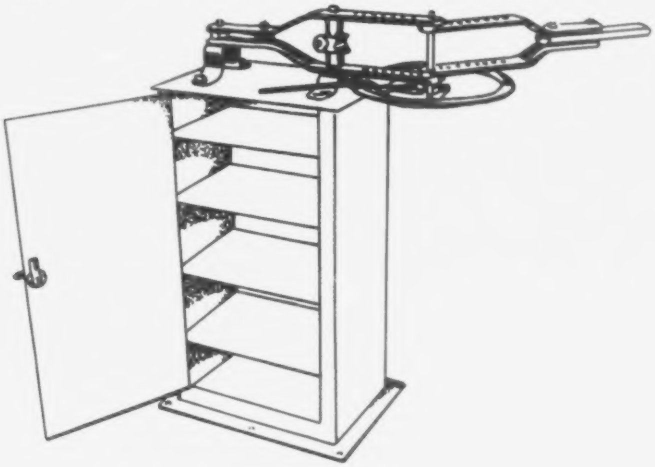
E. Angle iron cutter, notcher, and bender — Used to cut, notch, and bend angle iron (Figure 63)

FIGURE 63



F. Hossfeld bender — Used to bend, form, and shape pipe, tubing, angle iron, flat bars, and straps (Figure 64)

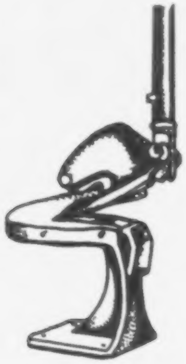
FIGURE 64



INFORMATION SHEET

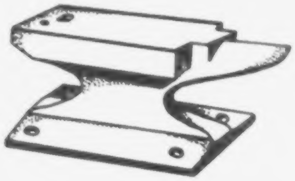
G. Beverly shear — Lever operated bench tool that makes distortion free cuts in straight or curved patterns on light to heavy metals (Figure 65)

FIGURE 65



H. Anvil — An iron or steel block with both flat and curved surfaces for shaping metals that are hammered or peened against it, and it sometimes has a tapered round end for curving metal strapping and other materials (Figure 66)

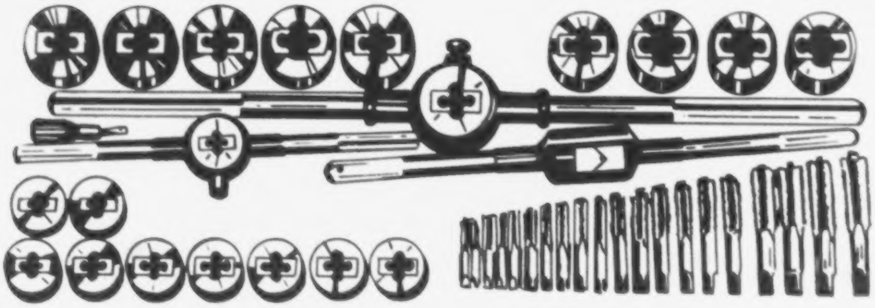
FIGURE 66



INFORMATION SHEET

I. Taps and dies — Tools used to cut female threads (taps) in metal or to cut threads on the outside (dies) of pipes or other round stock, and they usually come in sets (Figure 67)

FIGURE 67

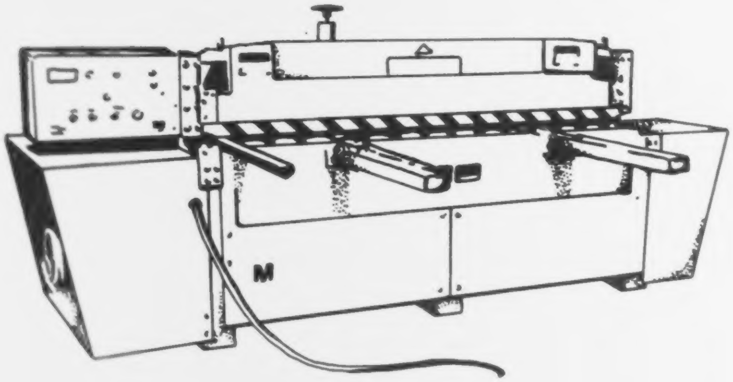


INFORMATION SHEET

XIV. Power equipment, its characteristics and uses

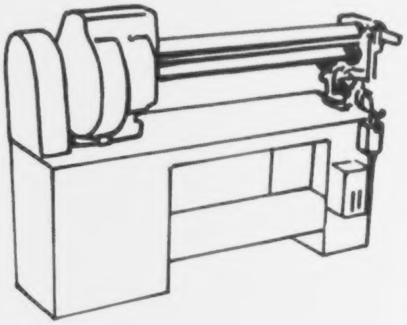
A. Power shears — Used to cut all gauges of metal and may be operated mechanically, hydraulically, or pneumatically (Figure 68)

FIGURE 68



B. Power roll — Used to shape both plate and structural metals into rounded forms (Figure 69)

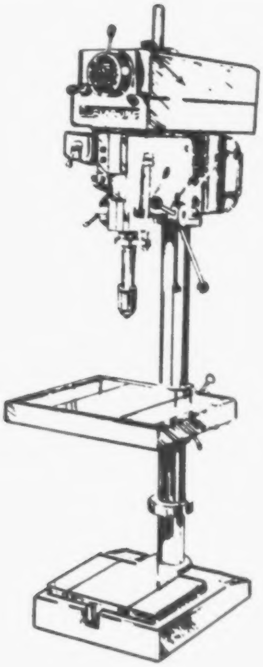
FIGURE 69



INFORMATION SHEET

C. Drill press — Used for drilling holes in several pieces of metal at one time or drilling single holes in heavier metals (Figure 70)

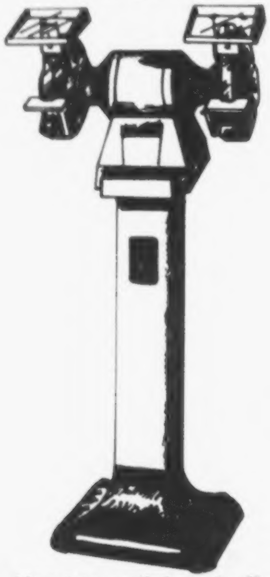
FIGURE 70



INFORMATION SHEET

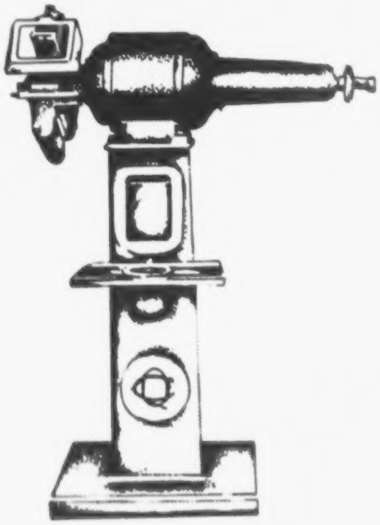
D. Pedestal grinder — Used for grinding all forms of metal (Figure 71)

FIGURE 71



E. Pedestal buffer — Used to polish or buff metals with wire, brush, or cloth wheels (Figure 72)

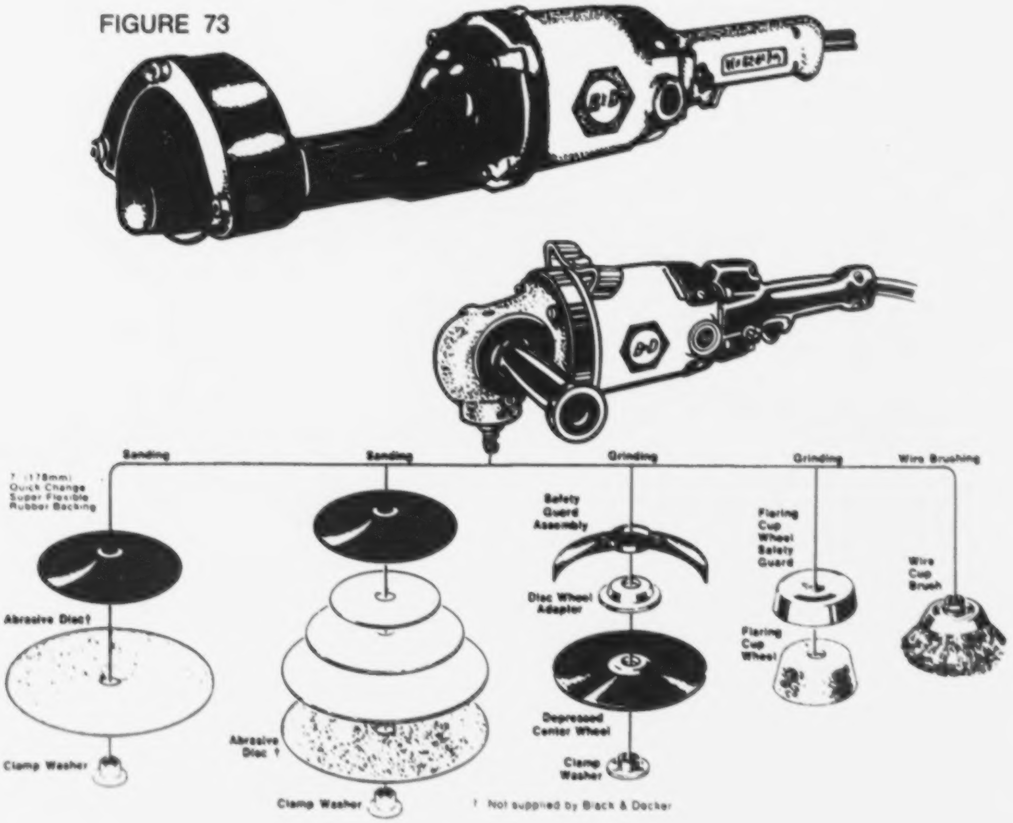
FIGURE 72



INFORMATION SHEET

F. Angle and straight grinders — Generally used with attachments for cleaning joints before or after a welding process (Figure 73)

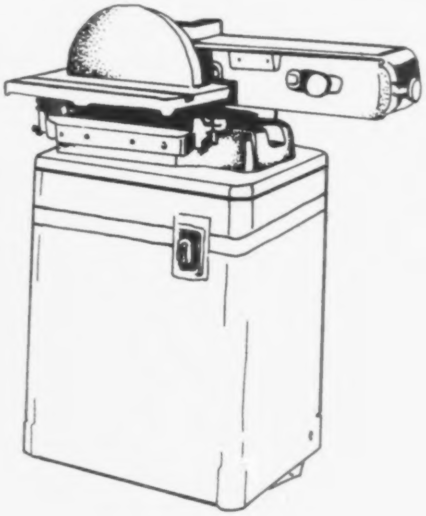
FIGURE 73


Sanding
Sanding
Grinding
Grinding
Wire Brushing
7" (178mm) Quick Change Super Flexible Rubber Backing
Abrasive Disc†
Clamp Washer
Abrasive Disc †
Clamp Washer
Safety Guard Assembly
Disc Wheel Adapter
Depressed Center Wheel
Clamp Washer
Flaring Cup Wheel Safety Guard
Flaring Cup Wheel
Wire Cup Brush
† Not supplied by Black & Decker

INFORMATION SHEET

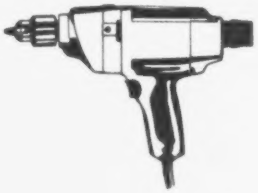
G. Belt and disc sander — Used to grind or sand flat metal surfaces (Figure 74)

FIGURE 74



H. Hand drill — Generally used for light drilling jobs, comes in several types such as variable-speed and reversible, and in 1/4", 3/8", and 1/2" sizes (Figure 75)

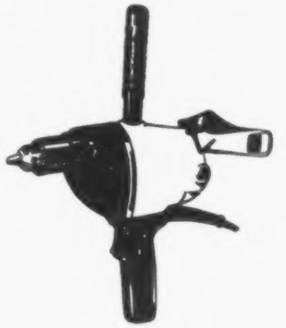
FIGURE 75



INFORMATION SHEET

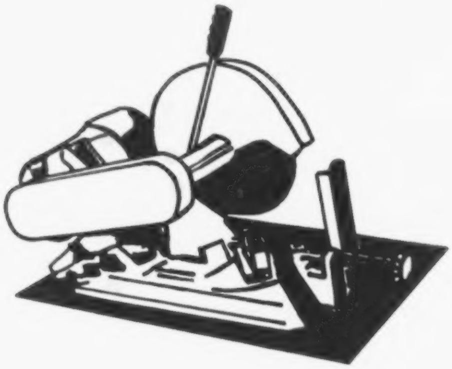
I. Heavy duty hand drill — Generally used for drilling thicker materials, comes in several types such as variable-speed and reversible, and in 1/2", 3/4", and 1 1/4" sizes (Figure 76)

FIGURE 76



J. Cut-off saw — Used to cut heavier metal at different angles or in straight cuts (Figure 77)

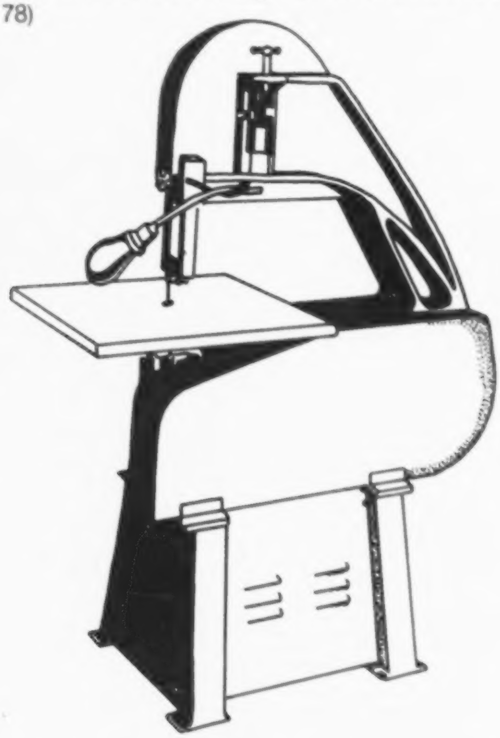
FIGURE 77



INFORMATION SHEET

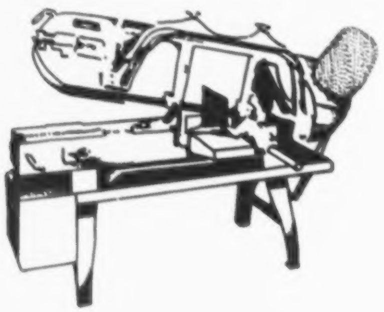
K. Vertical band saw — Used for cutting mild steel with a continuous cutting blade (Figure 78)

FIGURE 78



L. Horizontal band saw — Used to cut any length or type of metal with a continuous cutting blade (Figure 79)

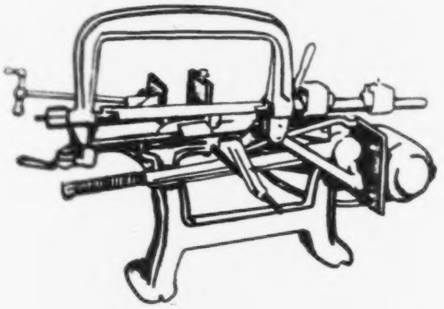
FIGURE 79



INFORMATION SHEET

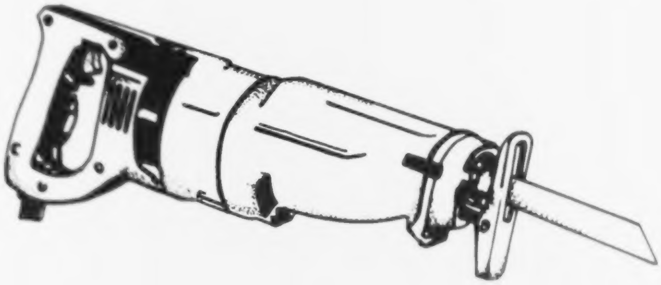
M. Power hacksaw — Used to cut any length or type of metal (Figure 80)

FIGURE 80



N. Reciprocating saw — Used like a key-hole saw with various types of blades to cut wood, metal, plastic, and even heavy steel (Figure 81)

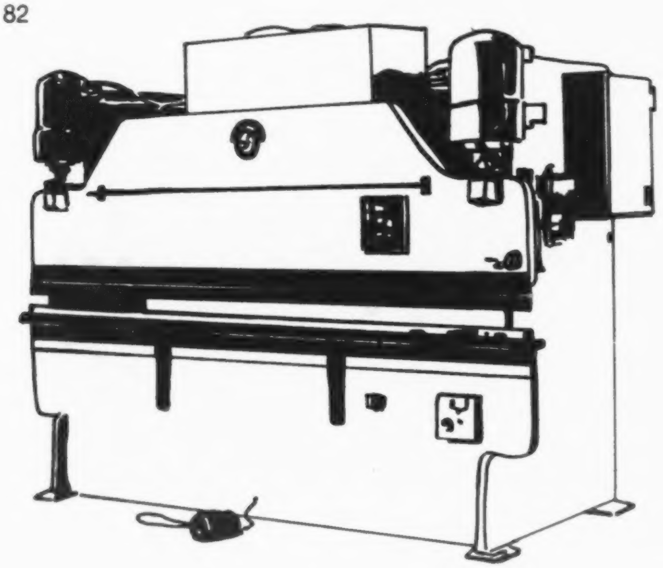
FIGURE 81



INFORMATION SHEET

O. Press brake — Used to press metal into varying shapes with different dies and punches and has capacities which run to three hundred tons and more (Figure 82)

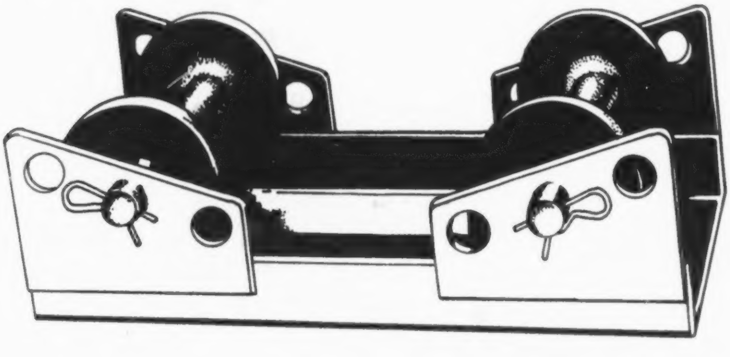
FIGURE 82



XV. Positioning equipment, its characteristics and uses

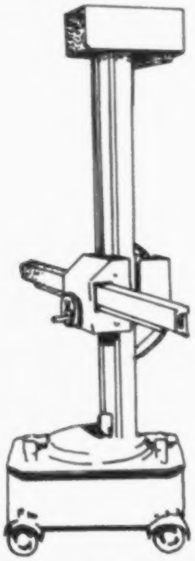
A. Turning rolls — Used to roll pipes or round objects and are typically used in production shops with automatic welding processes (Figure 83)

FIGURE 83



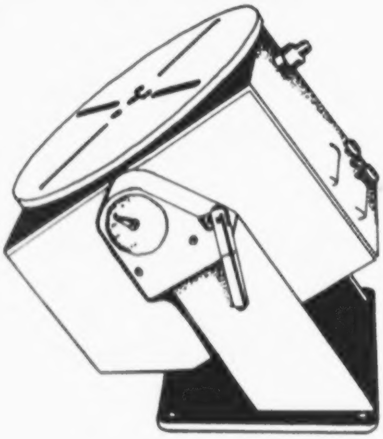
B. Manipulators — Used to control and position welding equipment on automatic positioners or turning rolls and are typically used in production shops with automatic welding processes (Figure 84)

FIGURE 84



C. Positioners — Used to secure and position objects being welded, can turn or rotate object at preset speed or be controlled manually by operator, and is typically used in a production shop (Figure 85)

FIGURE 85



INFORMATION SHEET

XVI. Basic rules for safe use of hand tools (Transparencies 6 and 7)

A. Do not use a screwdriver as a prying tool

B. Do not use pliers to loosen or tighten nuts and bolts

C. Do not use any tool with a loose handle or defective part

D. When using a screwdriver, support the work on a bench or against a solid surface

E. When using a wrench, pull it toward yourself to prevent smashing your hand if the wrench should slip

F. Never use a file without a handle

G. Secure small parts or objects before working on them with hand tools

H. Never strike the mushroomed head of a punch or chisel

XVII. Basic rules for safe use of power tools and equipment

A. Do not use power tools until you have been instructed how to safely use them and have permission from your instructor

B. Check electrical cords and plugs before using electrical power tools, and check lines and connections before using air-operated tools

C. When working with a drill press, always clamp the workpiece in place or it will spin with the drill bit

D. Make sure shields and guards are securely in place before using power equipment

E. Avoid walking into restricted safety zones marked off around power equipment

F. When using extension cords with power equipment, make sure they are grounded and free of breaks or frays

G. Wear no loose or frayed clothing around rotating equipment

H. Pay attention to safety signs and warning tags

I. Know emergency shut-down procedures for all power equipment

J. Keep tools clean and dry

INFORMATION SHEET

XVIII. Basic rules for maintaining tools and equipment

A. The number one rule for maintaining a tool or a piece of equipment is to use it only for its intended purpose

B. Any tool or piece of equipment suspected of being faulty should be tagged and reported

C. Properly record and date information placed on lubrication and maintenance schedules

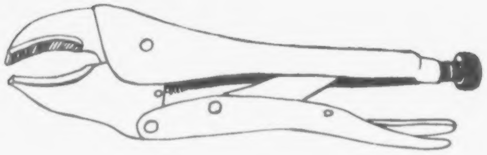
D. Always disconnect the power supply when performing maintenance on power tools and equipment

E. Check tool rests on pedestal grinders daily

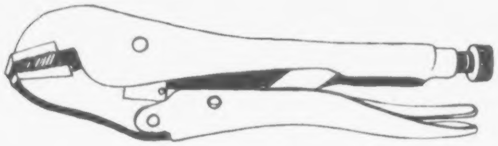
F. Check grinding wheels daily and dress as needed

G. Check oil pressure on shears before using them

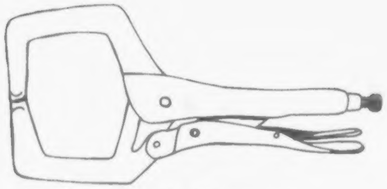
Vise-Grip® Clamps



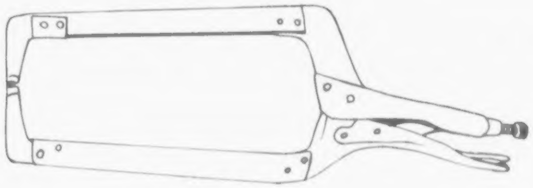
Curved Jaw



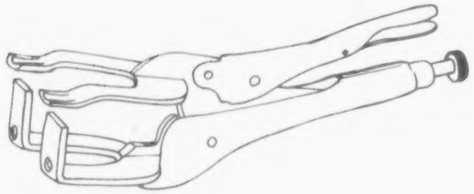
Straight Jaw



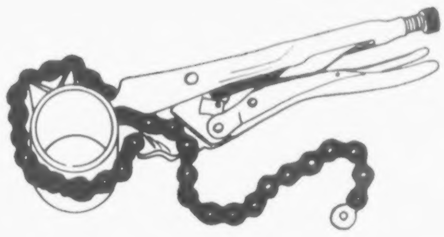
"C" Clamp



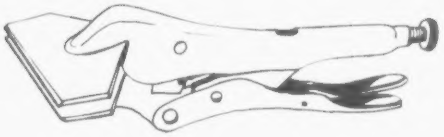
Long-Reach
"C" Clamp



Welding Clamp

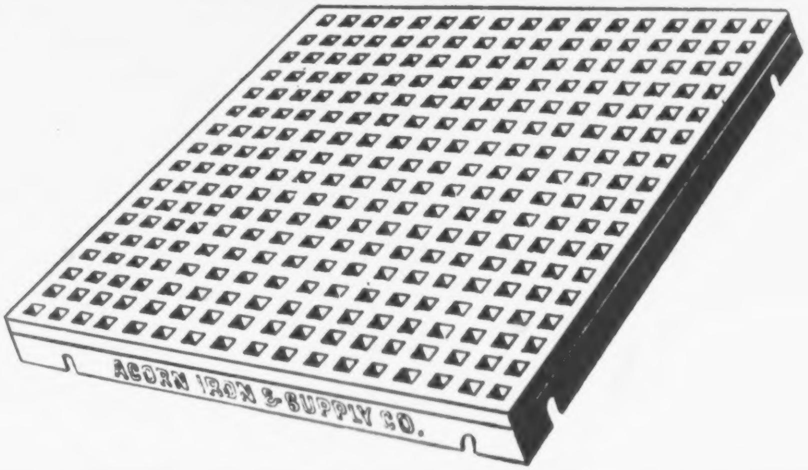


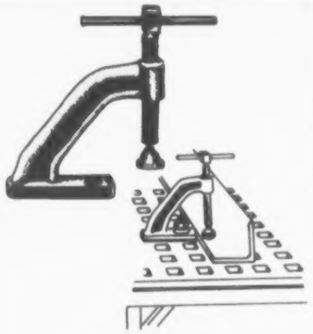
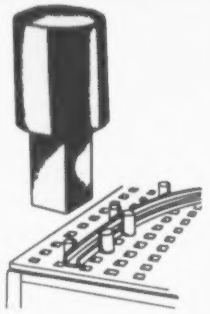
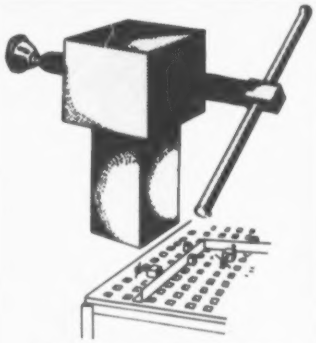
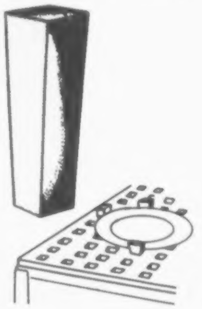
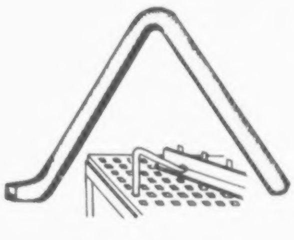
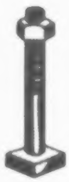
Chain Clamp



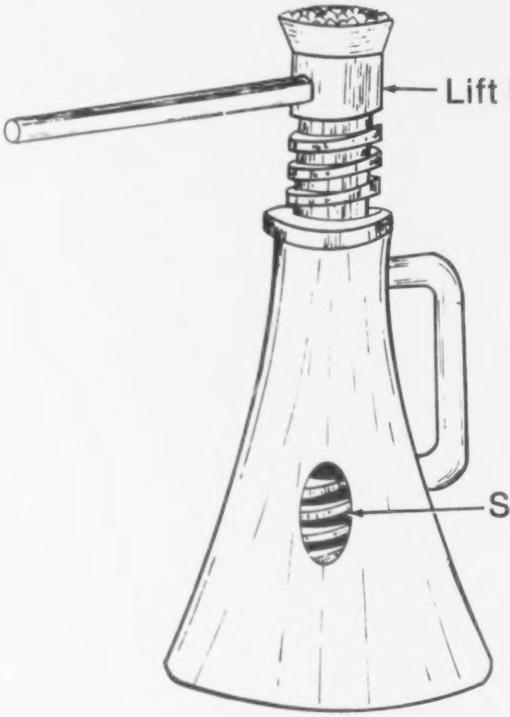
Sheet Metal Tool

Platen Table, Tools and Accessories

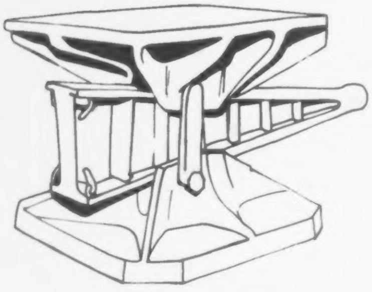

ACORN IRON & SUPPLY CO.

 Arm Clamp	 Bending Post	 Horizonal Clamp
 Tapered Drift Pin	 Gooseneck Hold-Down Dog	 Special Hold-Down Bolt & Nut

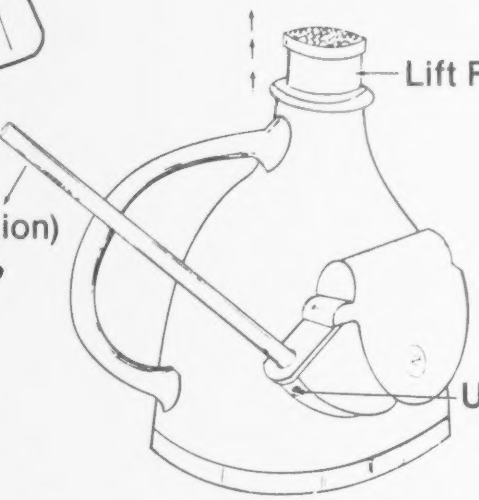
Types of Jacks


Lift Ram
Safety Peep Hole

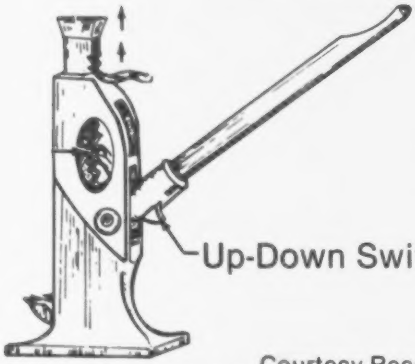
Screw Jack



Wedge Jack


Lift Ram
(Ratchet Action)
Up-Down Button

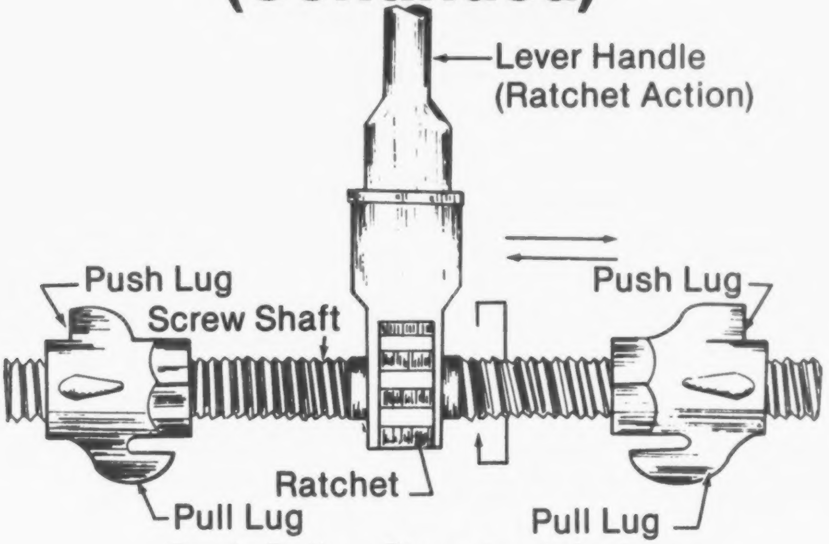
Journal or Bottle Jack


Up-Down Switch

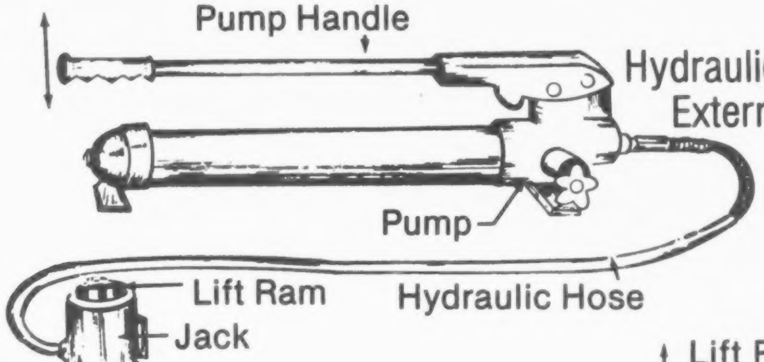
Ratchet Lever or Railroad Jack

Courtesy Research and Curriculum Unit for Vocational-Technical Education, College of Education, Mississippi State University, Mississippi State, Mississippi

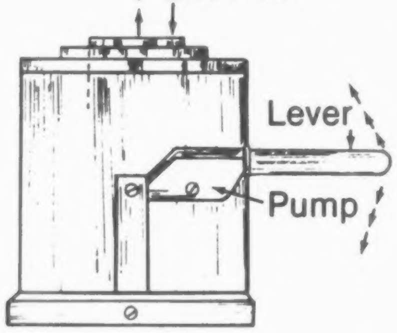
Types of Jacks (Continued)


Lever Handle (Ratchet Action)
Push Lug
Screw Shaft
Push Lug
Ratchet
Pull Lug
Pull Lug

Push-Pull or Steamboat Jack


Pump Handle
Pump
Hydraulic Hose
Lift Ram
Jack

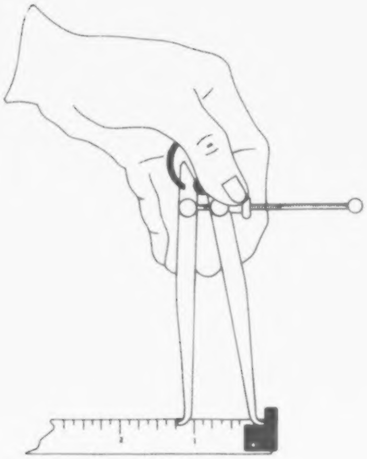
Hydraulic Jack with External Pump


Lift Ram
Lever
Pump

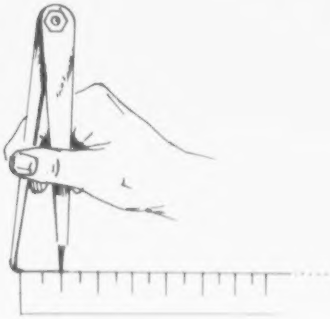
Self-Contained Hydraulic Jack

Courtesy Research and Curriculum Unit for Vocational-Technical Education, College of Education, Mississippi State University, Mississippi State, Mississippi

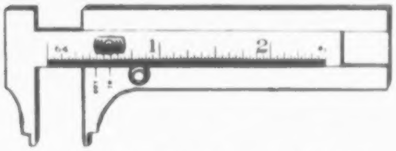
Types of Calipers



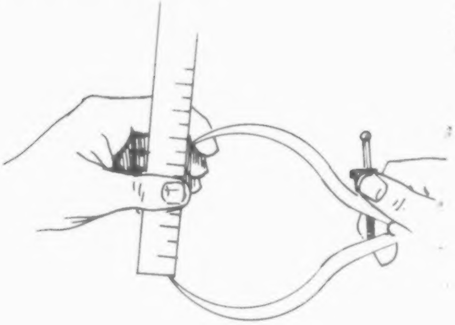
Inside Caliper



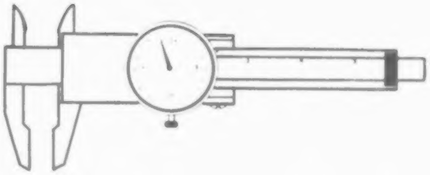
Hermaphrodite Caliper



Slide Caliper Rule

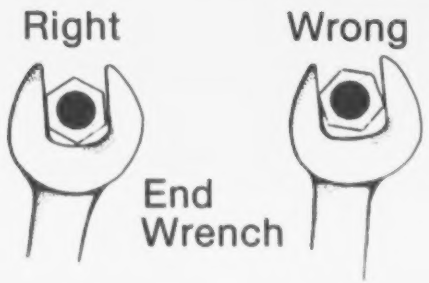


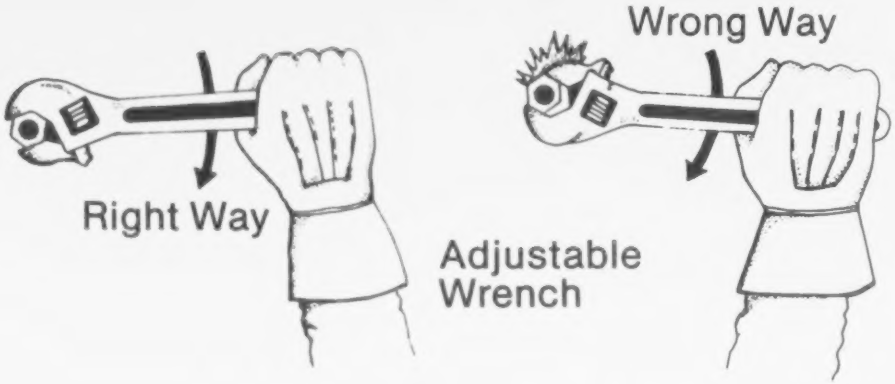
Outside Caliper

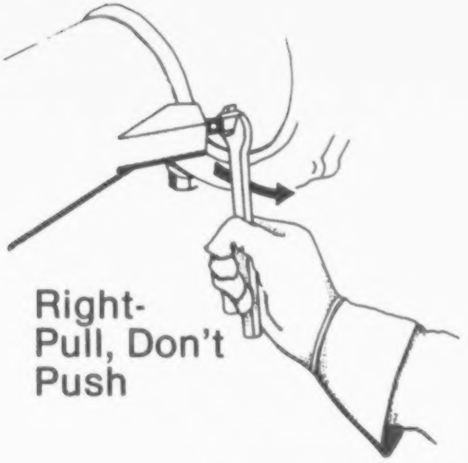


Dial Caliper

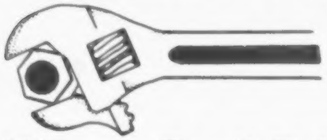
Right and Wrong Use of Tools

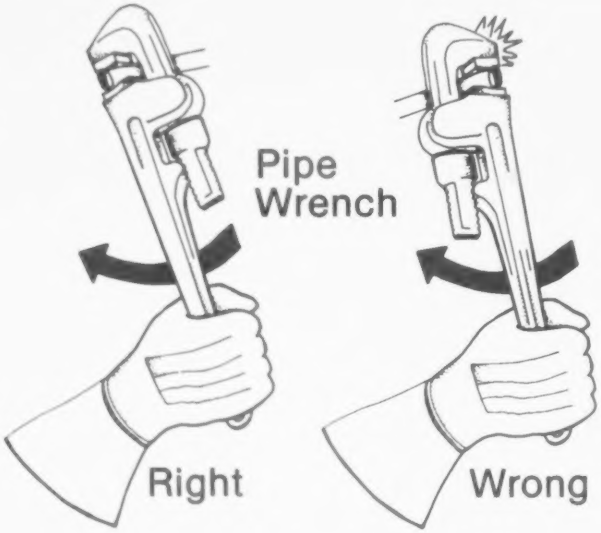

Right
Wrong
End Wrench


Right Way
Wrong Way
Adjustable Wrench

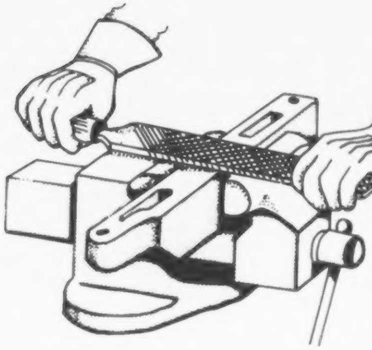

Right-
Pull, Don't
Push

End Wrench-
Adjustable Wrench


Wrong - Don't Pull
on an Adjustable
Wrench Until It has
Been Tightened on
the Nut

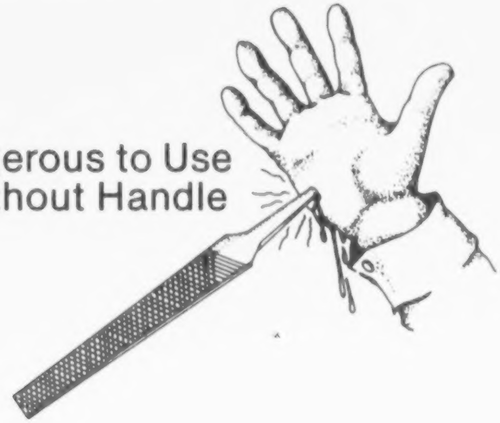

Pipe Wrench
Right
Wrong

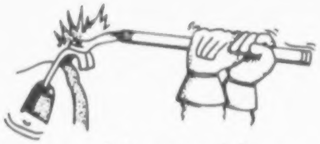
Right and Wrong Use of Tools (Continued)



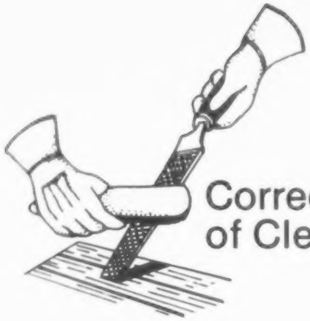
Correct Method of Draw-Filing

It is Dangerous to Use a File Without Handle

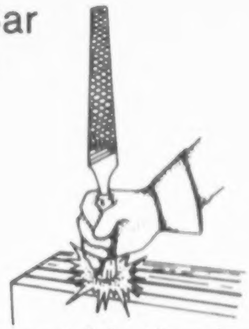




Wrong - Never Use a Bar or a Pipe on a Wrench

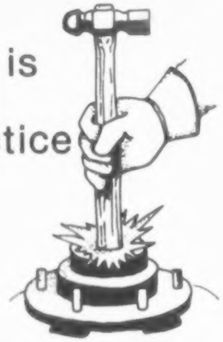


Correct Method of Cleaning a File



Correct Method of Tightening File Handle

This is Bad Practice

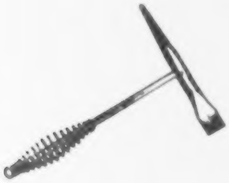


Incorrect Use of a Hammer

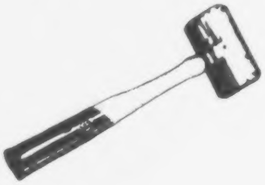
WELDING TOOLS AND EQUIPMENT
UNIT III

ASSIGNMENT SHEET #1 — IDENTIFY BASIC HAND TOOLS

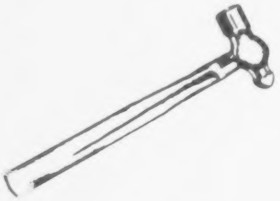
Directions: Write the correct name of the hand tool below each illustration.



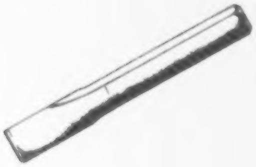
a. ____________________



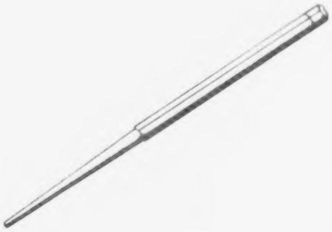
b. ____________________



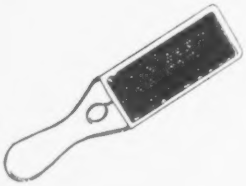
c. ____________________



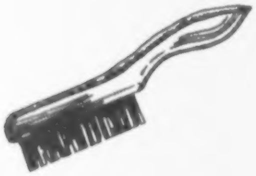
d. ____________________



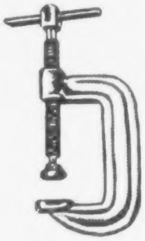
e. ____________________



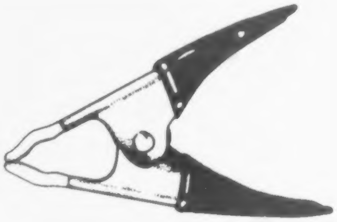
f. ____________________



g. ____________________

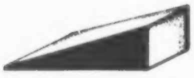


h. ____________________

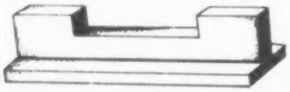


i. ____________________

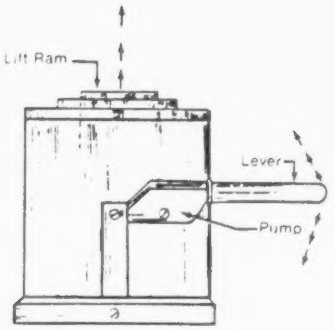
ASSIGNMENT SHEET #1



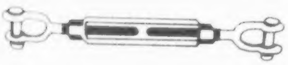
j. ______________________



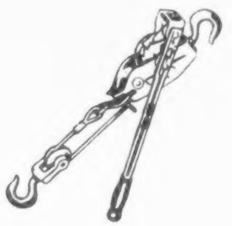
k. ______________________


Lift Ram
Lever
Pump

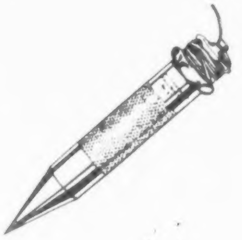
l. ______________________



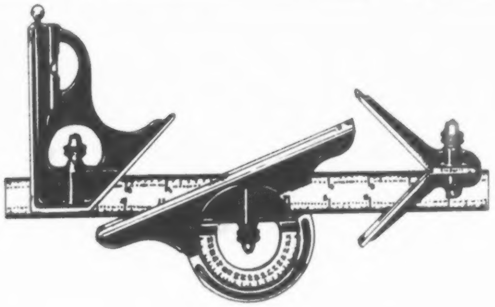
m. ______________________



n. ______________________



o. ______________________

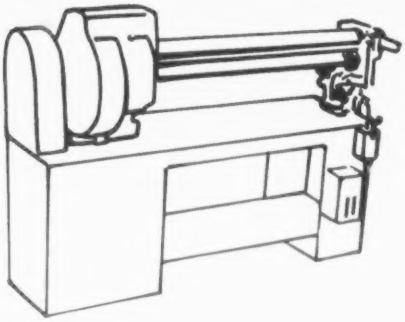


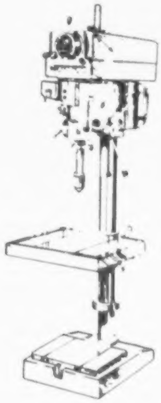
p. ______________________

WELDING TOOLS AND EQUIPMENT
UNIT III

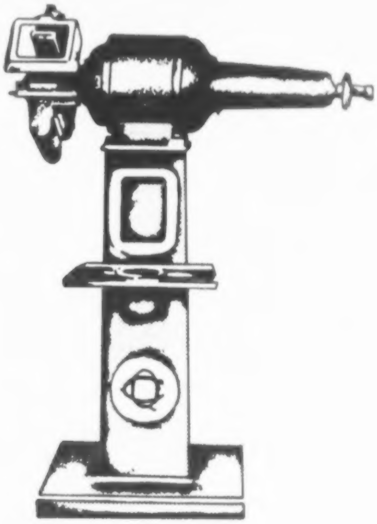
ASSIGNMENT SHEET #2 — IDENTIFY BASIC POWER TOOLS AND EQUIPMENT

Directions: Write the correct name of the power tool or piece of power equipment below each illustration.



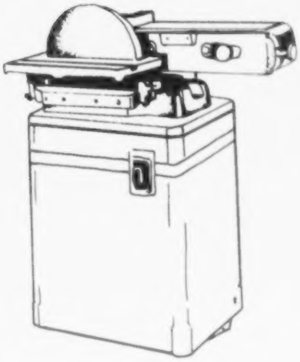


a. ______________________ b. ______________________

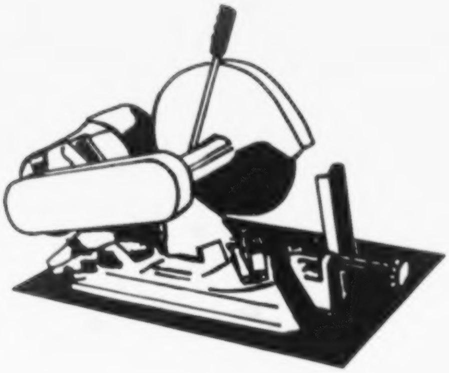


c. ______________________

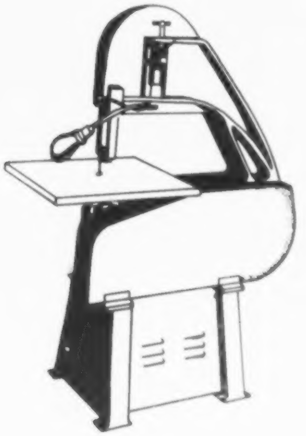
ASSIGNMENT SHEET #2



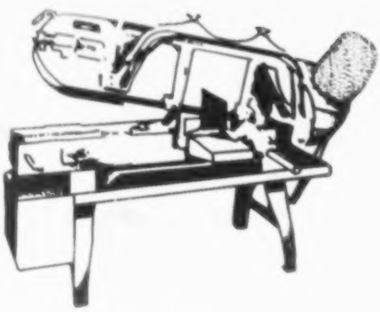
d. ____________________



e. ____________________

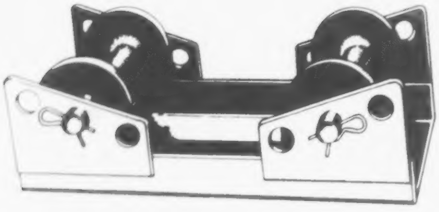


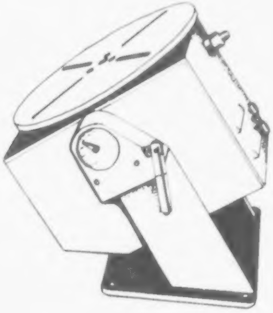
f. ____________________



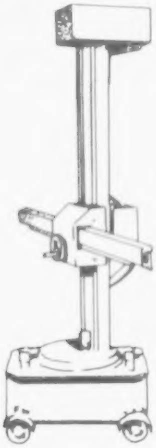
g. ____________________

ASSIGNMENT SHEET #2





h. ______________________________ i. ______________________________



j. ______________________________

WELDING TOOLS AND EQUIPMENT
UNIT III

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

a. Chipping hammer
b. Mallet
c. Ball peen hammer
d. Cold chisel
e. Drift punch
f. Card file
g. Wire brush
h. C-clamp
i. Spring clamp
j. Wedge
k. Strongback
l. Self-contained hydraulic jack
m. Turnbuckle
n. Come-along
o. Plumb bob
p. Combination square

Assignment Sheet #2

a. Power roll
b. Drill press
c. Pedastal buffer
d. Belt and disc sander
e. Cut-off saw
f. Vertical band saw
g. Horizontal band saw
h. Turning roll
i. Positioner
j. Manipulator

WELDING TOOLS AND EQUIPMENT
UNIT III

NAME ____________________

TEST

1. Match the terms on the right with their correct definitions.

_____a. The measured thickness of metal or wire or an instrument to measure that thickness

_____b. A form or frame used to mass produce a part or to control distortion during a welding process

_____c. A metal-cutting machine with operating power from a clutch or a flywheel that provides high-speed operation

_____d. A metal-cutting machine with operating power from fluid transport lines to provide a slower rate of operation than other shears

_____e. A metal-cutting machine with operating power from compressed air in transport lines to provide a slower rate of operation than other shears

_____f. Extremely hard, precisely shaped metal molds used on a press brake for forming angles and shapes in metal

_____g. Platforms or bases designed to secure and manipulate welded products so that welding can usually be accomplished from one position to increase welding speed and weld quality

1. Hydraulic shear
2. Dies and punches
3. Gauge
4. Positioners
5. Jig
6. Pneumatic shear
7. Mechanical shear

2. Match driving and chipping tools with their characteristics and uses.

_____a. Used to remove slag and residue left on metals after welding or cutting

_____b. A heavy hammer with two driving heads used to drive wedges under and between materials, and comes in weights of 40, 48, or 64 ounces

1. Mallets
2. Chipping hammer

TEST

_____c. Used where a metal hammer would dent or damage material, and made of hickory, rawhide, lead, nylon, rubber, or composition materials

_____d. A long-handled hammer used when more driving force is needed than a smaller hammer can deliver, comes in weights from 2 to 20 pounds, and is designed to be used with both hands

_____e. A general purpose hammer with a curved face and a rounded head, comes in weights from 4 to 48 ounces, and is usually used with one hand

3. Ball peen hammer
4. Fitter's or engineer's hammer
5. Sledge hammer

3. Match chisels, punches, and pry bars with their uses.

_____a. Used for cutting metal, rivets, nuts, and bolts

_____b. Used for cutting keyways in metal

_____c. Used for cutting V-grooves and cleaning out inside corners

_____d. Used for cutting U-shaped grooves in metal

_____e. Used for driving out straight or tapered pins

_____f. Used for prying, positioning, and aligning parts in fit-up

1. Drift punch
2. Diamond-point chisel
3. Cold chisel
4. Aligning pry bar
5. Cape chisel
6. Round-nose chisel

4. Select true statements concerning files, their uses, basic shapes, and cuts by placing an "X" in the appropriate blanks.

_____a. Files — Used manually to remove metal stock

_____b. Basic shapes of files — Triangular, flat, square, round or rat-tail, and half round to provide a shape to match the job need

_____c. Basic file cuts — From single-cut coarse to double-cut smooth to provide textures that produce specific finishes

_____d. Card file — Used to sharpen files

_____e. File handle — Used to cover the tang of a file and protect against injury, and a file must not be used without a handle

TEST

5. Complete statements concerning wire brushes, their types and uses by inserting the word(s) that best completes each statement.

   a. Uses — For cleaning a weld area ____________ or ____________ welding

   b. Types — Steel wire bristles or ______________________ bristles with shoe handles or bent handles

6. Match holding and anchoring tools with their characteristics and uses.

______a. Plier-type devices used to hold materials until they can be tacked in place, adjustable to almost any metal gauge, and handy to work with because they go on and come off quickly

   1) Curved jaw
   2) Straight jaw
   3) C-clamp
   4) Long-reach C-clamp
   5) Welding clamp
   6) Sheet metal
   7) Chain clamp

______b. Adjustable vise-like devices used to hold materials together until they can be joined by other means, and will hold longer and wider materials than a vise can

______c. Used to hold two or more pieces of material together until they can be tacked or joined together by other means

______d. Used to secure a tape line to the end of a piece of material or to secure light detail material onto main members

______e. Used to secure workpieces that cannot or should not be held by hand, usually fastened to a work bench, and have opposing jaws adjustable with a screw-type movement

______f. Used to eliminate welding and bending jigs and has special accessories used in layout and various other welding activities

1. Spring clamps
2. Platen table
3. Vises
4. Vise-grip® clamps
5. C-clamps
6. Bar clamps

TEST

7. Match alignment tools with their uses.

_____a.	Used to fit-up two or more pieces of material by inserting a V-shaped end in between pieces and striking the head or opposite end with a hammer to obtain vertical or horizontal alignment	1.	Wedges
_____b.	Used as a restraining device so that wedges can be applied and driven	2.	Clip plates or dogs
_____c.	Used as restraining devices so that wedges can be applied and driven in situations where other devices would not provide enough strength	3.	Flat bar, yoke, and strongback

8. List three types of jacks.

a. ____

b. ____

c. ____

9. Match pulling and lifting tools with their characteristics and uses.

_____a.	Used to adjust lengths of wire rope or steel rod, and are adjustable for taking up slack and inducing a load or being slacked off to reduce a load	1.	Come-alongs
_____b.	Used as manually operated hoists, are portable, easy to set-up, and may be constructed with chain or cable	2.	Plate dogs
_____c.	Used to lift plates safely and move them from one place to another	3.	Slings
_____d.	Cables and hooks or chains and hooks used in single, double, triple, or quadruple arrangement for lifting and moving heavy objects	4.	Turnbuckles

TEST

10. Match measuring tools with their characteristics and uses.

_____a. Used to measure gauges, set lines, holes, and work points and many other straight line measurements up to 25′, and is often used by fitters so it is made to be carried on a welder's belt

_____b. Used to measure the thickness or gauge of sheet metal, plate, and wire

_____c. Used to assure that drill tips being sharpened are kept centered at an angle of 59° so that they will cut faster with less applied force

_____d. Used to construct small circles and arcs and transfer measurements

_____e. Used for inside and outside measurements

1) Inside
2) Outside
3) Hermaphrodite
4) Slide
5) Dial

_____f. Measuring devices graduated in whole units and fractions and used in measuring distances ranging from fractions of an inch up to 48 inches

1) Narrow flexible
2) Steel
3) Hook

_____g. Devices used to check surfaces for true alignment horizontally, vertically, or at a 45° angle

_____h. Used to check related members for alignment or plumb, cord or string length varies, and common weights range from 6 ounces to 24 ounces

1. Levels
2. American and U.S. standard metal gauges
3. Rules
4. Plumb bob
5. Drill point gauge
6. Pocket tape
7. Wing dividers
8. Calipers

TEST

_____i. Chalk-coated line stretched tightly and snapped sharply to mark a straight line between two points, and can also be used to check for straightness in plate and structural metals

_____j. Used to make puncture marks, to locate centers of holes, or establish work points or center lines on materials

_____k. Used most often to make punch marks along layout lines to provide permanent references for chalked or scribed lines that might wear off in handling

_____l. Used to lay out bevel lines or check materials cut on a bevel, and can be adjusted to all angles

_____m. Used to square detail material, square head is used for 45° and 90° angles, protractor head is used to read angles from 0° to 180°, and center head is used to find the center of round materials

_____n. Used to measure distances between points, used for layout work and for squaring, and generally longer than 25′

_____o. Used primarily by fitters to check trueness of flanges and angles, used for setting and checking bevel squares, and edges marked with rule-like graduations make it a good measuring tool

_____p. Used to measure inside, outside, or depth of parts that require critical tolerances

9. Framing square
10. Prick punch
11. Chalk line
12. Combination square
13. Center punch
14. Micrometers
15. Steel tapes
16. Bevel square

11. Match turning tools and wrenches with their uses.

_____a. Used to tighten or loosen different sizes of nuts and bolts

_____b. Used to tighten or loosen specific sizes of nuts and bolts

_____c. Used to tighten or loosen specific sizes of nuts and bolts

1. Screwdrivers
2. Allen wrenches
3. Torch wrenches

TEST

______d. Used primarily for fitting up pipe, but handy for holding and aligning because of its vise-like adjustable jaws

______e. Used specifically for tightening or loosening cylinder connections on oxyacetylene equipment because adjustable wrenches can easily damage the brass fittings used on oxyacetylene equipment

______f. Used specifically for tightening or loosening torch connections where the use of adjustable wrenches or pliers might damage brass fittings

______g. Used to tighten or loosen specific types of screws, bolts, and other anchoring devices

______h. Hex-shaped key-type wrenches used to tighten or loosen specific sizes of special screws or bolts

______i. Used to tighten or loosen specific sizes of nuts and bolts with a variety of socket sizes and handles for various jobs

4. Adjustable wrench
5. Box-end wrench
6. Socket wrench and handles
7. Pipe wrench
8. Cylinder wrenches
9. Open-end wrench

12. Match pliers with their uses.

______a. Used for handling hot metal or materials

______b. Used for cutting small diameter wire, and frequently used in GMAW welding

______c. Used for cleaning cups and nozzles, cutting small diameter wire, holding, and bonding, and used mostly in GMAW welding

______d. Used to cut larger diameter wire, holding, and is used in submerged arc welding

1. Needle nose
2. Diagonal cutters
3. Slip joint
4. Lineman's

TEST

13. Match other manual cutting and shaping tools with their uses.

______a. Used to manually cut or separate metal

______b. Used to cut straight lines or curves on light-gauge metal and also available in left or right cuts

______c. Used to cut small diameter nuts, bolts, rod, and chain

______d. Used for cutting small-diameter pipe or tubing

______e. Used to cut, notch, and bend angle iron

______f. Used to bend, form, and shape pipe, tubing, angle iron, flat bars, and straps

______g. Lever operated bench tool that makes distortion free cuts in straight or curved patterns on light to heavy metals

______h. An iron or steel block with both flat and curved surfaces for shaping metals that are hammered or peened against it, and it sometimes has a tapered round end for curving metal strapping and other materials

______i. Tools used to cut female threads in metal or to cut threads on the outside of pipes or other round stock, and they usually come in sets

1. Pipe cutters
2. Taps and dies
3. Angle iron cutter, notcher, and bender
4. Anvil
5. Hacksaw
6. Beverly shear
7. Straight-cut snips
8. Hossfeld bender
9. Bolt cutters

14. Match power equipment with its characteristics and uses.

______a. Used to cut all gauges of metal and may be operated mechanically, hydraulically, or pneumatically

______b. Used to shape both plate and structural metals into rounded forms

______c. Used for drilling holes in several pieces of metal at one time or drilling single holes in heavier metals

______d. Used for grinding all forms of metal

______e. Used to polish or buff metals with wire, brush, or cloth wheels

1. Angle and straight grinders
2. Cut-off saw
3. Hand drill
4. Power shears
5. Vertical band saw

TEST

_____f. Generally used with attachments for cleaning joints before or after a welding process

_____g. Used to grind or sand flat metal surfaces

_____h. Generally used for light drilling jobs, comes in several types such as variable-speed and reversible, and in 1/4", 3/8", and 1/2" sizes

_____i. Generally used for drilling thicker materials, comes in several types such as variable-speed and reversible, and in 1/2", 3/4", and 1 1/4" sizes

_____j. Used to cut heavier metal at different angles or in straight cuts

_____k. Used for cutting mild steel with a continuous cutting blade

_____l. Used to cut any length or type of metal with a continuous cutting blade

_____m. Used to cut any length or type of metal

_____n. Used like a key-hole saw with various types of blades to cut wood, metal, plastic, and even heavy steel

_____o. Used to press metal into varying shapes with different dies and punches and has capacities which run to three hundred tons and more

6. Drill press
7. Heavy duty hand drill
8. Pedastal grinder
9. Horizontal band saw
10. Belt and disc sander
11. Pedastal buffer
12. Power roll
13. Reciprocating saw
14. Press brake
15. Power hacksaw

15. Match positioning equipment with its characteristics and uses.

_____a. Used to roll pipes or round objects and are typically used in production shops with automatic welding processes

_____b. Used to control and position welding equipment on automatic positioners or turning rolls and are typically used in production shops with automatic welding processes

_____c. Used to secure and position objects being welded, can turn or rotate object at preset speed or be controlled manually by operator, and is typically used in a production shop

1. Manipulators
2. Turning rolls
3. Positioners

TEST

16. Complete statements concerning basic rules for safe use of hand tools by inserting the word(s) that best completes each statement.

    a. Do not use a screwdriver as a ______________ tool

    b. Do not use pliers to ______________ or ______________ nuts and bolts

    c. Do not use any tool with a loose ______________ or defective part

    d. When using a screwdriver, support the work on a bench or against a ______________ surface

    e. When using a wrench, pull it ______________ yourself to prevent smashing your hand if the wrench should slip

    f. Never use a file without a ______________

    g. ______________ small parts or objects before working on them with hand tools

    h. Never ______________ the mushroomed head of a punch or chisel

17. Select true statements concerning basic rules for safe use of power tools and equipment by placing an "X" in the appropriate blanks.

    ______a. Do not use power tools until you have been instructed how to safely use them and have permission from your instructor

    ______b. Check electrical cords and plugs before using electrical power tools, and check lines and connections before using air-operated tools

    ______c. When working with a drill press, always clamp the workpiece in place or it will spin with the drill bit

    ______d. Make sure shields and guards are securely in place before using power equipment

    ______e. Avoid walking into restricted safety zones marked off around power equipment

    ______f. When using extension cords with power equipment, make sure they are extra long

    ______g. Wear no loose or frayed clothing around rotating equipment

    ______h. Pay attention to safety signs and warning tags

TEST

_____i. Know emergency shut-down procedures for all power equipment

_____j. Keep tools clean and dry

18. List the number one rule for maintaining a tool or piece of equipment.

Answer: ____

____

19. Identify basic hand tools.

20. Identify basic power tools and equipment.

(NOTE: If these activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

WELDING TOOLS AND EQUIPMENT
UNIT III

ANSWERS TO TEST

1. a. 3 e. 6
   b. 5 f. 2
   c. 7 g. 4
   d. 1

2. a. 2
   b. 4
   c. 1
   d. 5
   e. 3

3. a. 3 d. 6
   b. 5 e. 1
   c. 2 f. 4

4. a, b, c, e

5. a. Before, after
   b. Stainless steel

6. a. 4 d. 1
   b. 6 e. 3
   c. 5 f. 2

7. a. 1
   b. 2
   c. 3

8. Any three of the following:

   a. Ratchet level jack (railroad jack)
   b. Journal jack (bottle jack or booby jack)
   c. Hydraulic jack with external pump
   d. Push-pull jack (steamboat jack)
   e. Self-contained hydraulic jack
   f. Wedge jack
   g. Screw jack

9. a. 4
   b. 1
   c. 2
   d. 3

ANSWERS TO TEST

10.	a.	6	i.	11
	b.	2	j.	13
	c.	5	k.	10
	d.	7	l.	16
	e.	8	m.	12
	f.	3	n.	15
	g.	1	o.	9
	h.	4	p.	14
11.	a.	4	f.	3
	b.	9 or 5	g.	1
	c.	5 or 9	h.	2
	d.	7	i.	6
	e.	8		
12.	a.	3		
	b.	2		
	c.	1		
	d.	4		
13.	a.	5	f.	8
	b.	7	g.	6
	c.	9	h.	4
	d.	1	i.	2
	e.	3		
14.	a.	4	i.	7
	b.	12	j.	2
	c.	6	k.	5
	d.	8	l.	9
	e.	11	m.	15
	f.	1	n.	13
	g.	10	o.	14
	h.	3		
15.	a.	2		
	b.	1		
	c.	3		
16.	a.	Prying		
	b.	Loosen, tighten		
	c.	Handle		
	d.	Solid		
	e.	Toward		
	f.	Handle		
	g.	Secure		
	h.	Strike		

ANSWERS TO TEST

17. a, b, c, d, e, g, h, i, j
18. Use it only for its intended purposes
19. Evaluated to the satisfaction of the instructor
20. Evaluated to the satisfaction of the instructor

BASIC METALS AND METALLURGY

UNIT IV

UNIT OBJECTIVE

After completion of this unit, the student should be able to list the mechanical and physical properties of metals, use numbering systems to identify metals, classify carbon steels, and identify standard metal shapes used in welding. The student should also be able to discuss residual stresses, select techniques for distortion control when welding, prepare a working reference for straightening a distorted member, and conduct magnet, spark, and chisel tests to identify metals. This knowledge will be evidenced by correctly completing the procedures outlined in the assignment and job sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to basic metals and metallurgy with their correct definitions.
2. Complete a list of reasons for proper metal identification.
3. Complete definitions of basic categories of metals.
4. Complete definitions of alloys and their characteristics.
5. Match tests for metal identification with their procedures.
6. Complete a list of two basic elements of metallurgy.
7. Match mechanical properties of metals with their characteristics.
8. Match types of mechanical strengths of metals with their meanings.
9. Match physical properties of metals with their characteristics.
10. Complete statements concerning the sub-zero temperature range and its effects on ferrous metals.
11. Complete statements concerning the black heat range and its effects on ferrous metals.
12. Complete statements concerning the red heat range and its effects on ferrous metals.
13. Complete statements concerning the white heat range and its effects on ferrous metals.
14. Select true statements concerning ways of testing properties of metals.

OBJECTIVE SHEET

15. Match principal alloying agents of steel with their characteristics.
16. Match metals with ways to identify them by appearance.
17. Solve problems concerning systems for identifying steel.
18. Complete a chart of carbon steel classifications, characteristics, and uses.
19. Complete a chart of alloy steel classifications, characteristics, and uses.
20. Complete a chart of iron classifications, characteristics, and uses.
21. Select true statements concerning aluminum, its characteristics and uses.
22. Solve problems concerning the AA system of identifying aluminum and aluminum alloys.
23. Solve problems concerning the AA temper designation system for aluminum.
24. Match other aluminum abbreviations with their meanings.
25. Arrange in order the steps in identifying aluminum.
26. Select true statements concerning chemical tests for identifying aluminum alloys.
27. Match other nonferrous metals with their typical uses.
28. Identify standard metal shapes available for welding.
29. Select true statements concerning equipment requirements for spark testing.
30. Select true references to terminology used in spark testing.
31. Select true statements concerning residual stresses and what they mean.
32. Complete statements concerning causes of residual stresses and distortion.
33. Match heat applications with their uses in weld quality control.
34. List situations where preheating is usually required.
35. Complete a list of methods of preheating and postheating.
36. Match torch preheating techniques with their applications.
37. Match types of steels with their recommended preheat temperatures.

OBJECTIVE SHEET

38. Match temperature-sensing devices with their use.
39. Complete statements concerning ways to control distortion in welding.
40. Complete statements concerning ways to control distortion with restraining devices.
41. Select true statements concerning guidelines for correcting distortion in welded components.
42. Arrange in order the procedure for straightening a distorted steel member.
43. Identify selected metals by appearance, color, and corrosion characteristics.
44. Identify metal shapes used for welding.
45. Prepare a working reference for straightening a distorted steel member.
46. Demonstrate the ability to:
    a. Conduct magnet tests to identify common metals used for welding.
    b. Conduct spark tests to identify common metals used for welding.
    c. Conduct chisel tests to identify common metals used for welding.

BASIC METALS AND METALLURGY
UNIT IV

SUGGESTED ACTIVITIES

I. Provide student with objective sheet.

II. Provide student with information and assignment sheets.

III. Make transparencies.

IV. Discuss unit and specific objectives.

V. Discuss information sheet.

VI. Discuss and demonstrate procedures outlined in the job sheets.

VII. Read assignment sheets and job sheets carefully, and tag metal samples as required.

VIII. Arrange for students to tour a metal supply company and have them report on the variety of different metal shapes they observe.

IX. Demonstrate the use of chemical tests for both ferrous and nonferrous metals and impress upon students the need for precautions when using acids and other chemicals used for testing.

X. Because the test for this unit is necessarily long, review it carefully and administer the test in two or three parts.

XI. Give test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

   A. Objective sheet

   B. Information sheet

   C. Transparency masters

      1. TM 1 — Metal Melting Points and Other Temperatures

      2. TM 2 — Heating Ranges for Ferrous Metals

      3. TM 3 — Spark Test Characteristics

INSTRUCTIONAL MATERIALS

4. TM 4 — Spark Test Characteristics (Continued)

5. TM 5 — Aluminum Hardness and Tempering Designations

D. Assignment sheets

1. Assignment Sheet #1 — Identify Selected Metals by Appearance, Color, and Corrosion Characteristics

2. Assignment Sheet #2 — Identify Metal Shapes Used for Welding

3. Assignment Sheet #3 — Prepare a Working Reference for Straightening a Distorted Steel Member

E. Answers to assignment sheets

F. Job sheets

1. Job Sheet #1 — Conduct Magnet Tests to Identify Common Metals Used for Welding

2. Job Sheet #2 — Conduct Spark Tests to Identify Common Metals Used for Welding

3. Job Sheet #3 — Conduct Chisel Tests to Identify Common Metals Used for Welding

G. Test

H. Answers to test

II. References:

A. *The Procedure Handbook of Arc Welding, Twelfth Edition*. Cleveland, OH 44117: The Lincoln Electric Company, 1973.

B. *New Lessons in Arc Welding*. Cleveland, OH 44117: The Lincoln Electric Company, 1981.

C. *Welding Kaiser Aluminum, First Edition*. Oakland, CA 94604: Kaiser Aluminum and Chemical Sales, Inc., 1967.

D. Repp, Victor E., and Willar J. McCarthy and Oswald A. Ludwig. *Metalwork Technology and Practice, Seventh Edition*. Bloomington, IL: McKnight Publishing Company. 1982.

E. Neely, John E. *Practical Metallurgy and Materials of Industry*. New York: John Wiley & Sons, Inc., 1979.

F. Althouse, Andrew D., and Carl H. Turnquist and William A. Bowditch. *Modern Welding*. South Holland, IL: The Goodheart-Willcox Co., Inc., 1980.

G. *Welding Handbook, Seventh Edition. Volume 4, Metals and Their Weldability*. Miami, FL 33126: American Welding Society, 1982.

BASIC METALS AND METALLURGY
UNIT IV

INFORMATION SHEET

I. Terms and definitions

   A. Metallurgy — The science of separating metals from their ores and smelting or refining them for use

   B. Filler metals — Metals added in making a brazed, welded, or soldered joint

   C. Preheating — Application of heat to a base metal before welding or cutting

   D. Interpass heating — Application of heat to a base metal during a welding process

   E. Postheating — Application of heat to welding or a weldment after a welding or cutting operation to promote a slower cooling rate and relieve stresses in the base metal and the weldment

   F. Weldment — Assembly of two or more metal parts with welding

   G. Compatibility — Two or more metals that have properties that can readily be welded

   H. AISI — American Iron and Steel Institute

   I. SAE — Society of Automotive Engineers

   J. Extruding — The process of forcing a heated metal through a special form to give it shape and length

   K. AA — Aluminum Association

   L. Strain-hardened — A metal that has had its strength increased without or with minimum thermal treatment

II. Reasons for proper metal identification

   A. Determines selection of filler metals

   B. Determines preheat, interpass, or postheat requirements

   C. Determines welding processes

   D. Determines compatibility of metals

INFORMATION SHEET

III. Basic categories of metals

A. Ferrous — Metals that contain iron as a major element

Example: Low, mild, medium, and high carbon steels, and cast iron

B. Nonferrous — Metals that contain no iron or extremely small amounts of iron

Example: Aluminum, copper, zinc, lead, tin, nickel, silver, titanium, and gold

IV. Alloys and their characteristics

A. Alloy — A metal formed by melting, fusing, or mixing two or more metals together

B. Alloy steels — Steels with one or more other metals added to give the steels certain characteristics or properties

(NOTE: Alloys may be either ferrous or nonferrous, but alloy steels are always ferrous.)

V. Tests for metal identification and their procedures

A. Magnet — A magnet will stick to ferritic alloys, but it will not stick to nonferritic alloys

B. File — Nonferrous metals can usually be filed easily, and ferrous metals are more difficult to file

C. Spark — Ferrous metals have definite spark patterns, and nonferrous metals have no spark patterns

D. Chemical — Certain chemicals or acids applied to metals cause different reactions

Example: A weak solution of nitric acid or copper sulfate applied to stainless steel will remain clear, but when applied to carbon steel will darken

E. Appearance — General surface appearance, color, and the presence of oxidation

Example: Some metals exposed to weather will rust, others will tarnish, and others will remain free of oxidation

F. Sound — When struck with a hammer, most metals have a characteristic ring or lack of it

Example: Steel has a higher-pitched ring than cast iron

INFORMATION SHEET

- G. Chisel — When chipped with a chisel, certain metals produce a continuous chip, others break up into small particles, and others cannot be chipped

  Example: Low carbon steel chips easily and leaves a continuous chip, but cast iron is not easy to chip and breaks up into small chips

VI. Basic elements of metallurgy

- A. Mechanical properties of metals
- B. Physical properties of metals

VII. Mechanical properties of metals and their characteristics

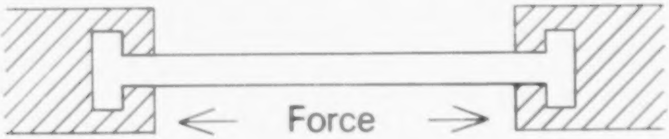
- A. Hardness — The capacity of a metal to resist penetration, abrasion, and deformation
- B. Strength — The capacity of a metal to resist changing its shape or size when exposed to external forces
- C. Ductility — The capacity of a metal to be permanently stretched without breaking
- D. Malleability — The capacity of a metal to be hammered or rolled into shape without breaking
- E. Brittleness — The tendency of certain metals to break or fracture if bent or struck sharply
- F. Elasticity — The capacity of a metal to return to its original size and shape when the force that changed it is removed
- G. Plasticity — The incapacity of a metal to return to its original size and shape when the force that changed it is removed
- H. Fatigue — The tendency of some metals to break or fracture under a repeated or sustained load
- I. Impact resistance — The capacity of a metal to absorb the impact of a load applied rapidly without failure
- J. Elongation — The measure of ductility of material measured in a tension test

INFORMATION SHEET

VIII. Types of mechanical strengths and their meanings

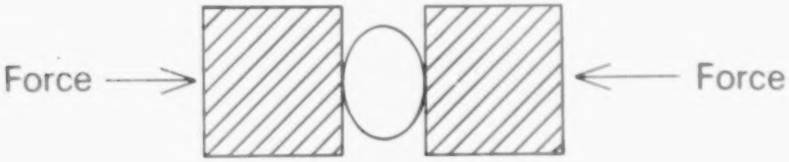
A. Tensile strength — The capacity of a metal to resist being pulled apart (Figure 1)

FIGURE 1



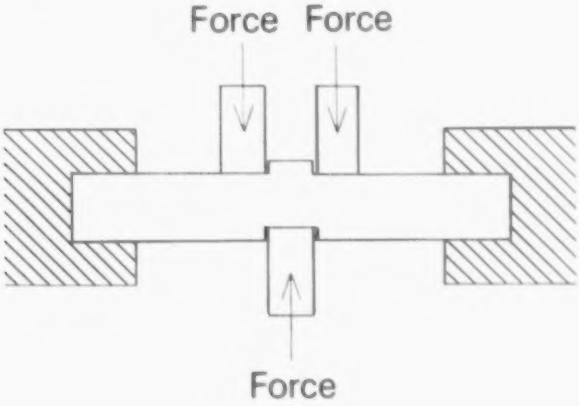
B. Compressive strength — The capacity of a metal to resist being pushed or crushed together (Figure 2)

FIGURE 2



C. Shear strength — The capacity of a metal to withstand a sustained load across its cross section (Figure 3)

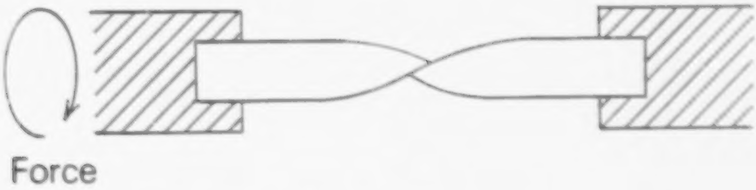
FIGURE 3



INFORMATION SHEET

D. Torsional strength — The capacity of a metal to resist twisting forces (Figure 4)

FIGURE 4



IX. Physical properties of metals and their characteristics

A. Density — The weight of a given piece of metal in relation to a unit size such as one cubic foot

Example: A cubic foot of aluminum weighs less than a cubic foot of steel so most steel has a greater density than most aluminum

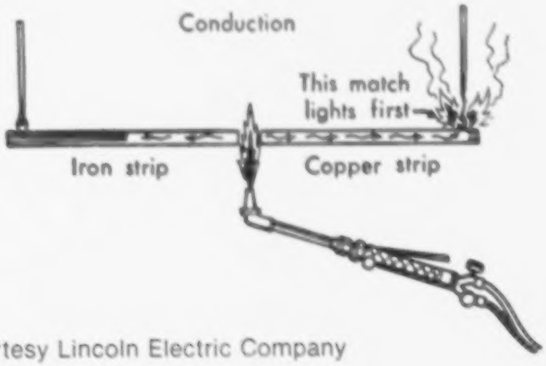
B. Electrical conductivity — The capacity of a metal to conduct electrical current

Example: Copper has a much higher electrical conductivity than steel and is used in many electrical wires

C. Thermal conductivity — The capacity of a metal to conduct heat (Figure 5)

Example: Silver and copper are metals that have high thermal conductivity

FIGURE 5



Courtesy Lincoln Electric Company

INFORMATION SHEET

D. Thermal expansion — The tendency of metals to expand when heated as expressed in terms of coefficient of expansion

(NOTE: Thermal expansion is extremely important in welding because a metal such as aluminum which has a high coefficient of thermal conductivity will readily spread heat throughout the workpiece and minimize distortion at the weld zone, but metals such as stainless steel with a low coefficient of thermal conductivity will localize the heat in the weld zone and cause a greater amount of distortion.)

E. Melting point — The point to which a metal must be heated before it will melt (Transparency 1)

X. Sub-zero temperature range and its effects on ferrous metals (Transparency 2)

A. Range extends from 0°F to −300°F

B. Almost all metals in this range have a lower impact resistance, and the lower the temperature, the lower the impact resistance

XI. Black heat range and its effects on ferrous metals (Transparency 2)

(NOTE: All temperatures given in the following color-coded heat ranges are based on steel with a zero percent carbon content. As carbon content in steel increases preheating temperatures increase and temperatures above the transformation range decrease.)

A. Range extends from 0°F to 1000°F

B. Includes the preheating range for welding which runs from about 60°F to just above 700°F

C. Includes blue brittle range from 300°F to 700°F, a range at which peening or working of steels should not be done since those metals are more brittle at this range than above or below it

D. Includes the nitriding range from abut 950°F to 1000°F, a range at which certain special steels are subjected to ammonia gas for long periods to give them extremely hard skin as the metal absorbs nitrogen

XII. Red heat range and its effects on ferrous metals (Transparency 2)

A. Range extends from 1000°F to 2050°F

B. Includes the stress relieving range which runs from about 1120°F to 1250°F, a range where temperatures are held long enough to relieve locked-up stresses, then the metal is slowly cooled to produce what is called process annealing

INFORMATION SHEET

C. Includes the spheroidizing range from about 1250°F to 1350°F, a range where temperatures are held long enough to produce a softness that usually provides good machinability

D. Includes the transformation range from about 1350°F to 1690°F, a range at which steels undergo a change in atomic arrangements which radically affect their properties

E. Includes the annealing and normalizing range from about 1400°F to 1750°F, a range where temperatures are held long enough to form austenite, then slowly cooled to produce small grain size, softness, and good ductility

F. Includes the carburizing range from about 1600°F to 1810°F, a range where carbon is dissolved into the surface of steel in the presence of carburizing compounds or gas mixtures to create hard, high-carbon steel

G. Includes forging range from about 1810°F to 2400°F, a range where metals can be mechanically worked or fused together

XIII. White heat range and its effects on ferrous metals (Transparency 2)

A. Range extends from 2050°F to 2900°F

B. Includes maximum forging temperature at 2400°F

C. Includes a transitional range where forging can no longer be done and burning begins

D. Includes a burning range from about 2490°F to 2550°F, a range at which steel is ruined and cannot be used again unless remelted

E. Includes a range above the burning range, up to 2900°F, at which steels become liquid

XIV. Ways of testing properties of metals

A. Brinell or Rockwell test for hardness

B. Shore scleroscope test for hardness

C. Hydraulic tests for tensile strength and ductility

D. Izod-Charpy test for impact resistance

INFORMATION SHEET

XV. Principal alloying agents of steel and their characteristics

A. Chromium — A grayish-white, hard metallic element used instead of carbon to make special steels that are less brittle but harder than other steels with the same carbon content

B. Nickel — A silvery-white, hard ductile metallic element used to make special steels with increased strength, improved ductility, and added toughness at low temperatures

C. Molybdenum — A silvery-white, hard metallic element used to make special steels that require increased hardness or strength in hot temperature surface applications

D. Vanadium — A silvery-white metallic element used to make special steels with added tensile strength

E. Carbon — A nonmetallic element added to iron to make steels that are harder and stronger

F. Tungsten — A steel-gray, brittle metallic element used to make special hard steels used in tool manufacturing

G. Silicon — A hard, brittle nonmetallic element used to make special steels that are hard and brittle

H. Manganese — A grayish-white, red-tinged nonmetallic element that is used to make special steels that are hard but less brittle

I. Cobalt — A hard, steel-gray element used to make steels subject to corrosive or high-temperature service

XVI. Metals and ways to identify them by appearance

A. Low, medium, and high carbon steel — Dark gray when new, but will rust with age, and rust rapidly when stored outside

B. Manganese steel — Dull cast surface when new, but will rust with age, and rust rapidly when stored outside

C. Stainless steel — Bright, silvery, and smooth when new, but some grades will rust and other grades will tarnish

D. Cast iron — Dull gray with evidence of sand mold, and will rust rapidly in almost any environment

E. Wrought iron — Light gray and smooth, and will rust rapidly in almost any environment

INFORMATION SHEET

F. Aluminum — Silvery-white with a smooth surface, is highly rust and corrosion resistant except when alloyed with certain other elements, and weighs much less than iron or steel

G. Copper — Reddish-brown with a dull finish, and highly subject to tarnishing

H. Nickel — White with a hard finish, and has a good resistance to rust and corrosion

XVII. Systems for identifying steel

A. Principal alloying ingredients are assigned numbers to assist with identification

1. Carbon
2. Nickel
3. Nickel-chromium
4. Molybdenum
5. Chromium
6. Chromium-vanadium
7. Tungsten
8. Nickel-chromium-molybdenum
9. Silicon-manganese

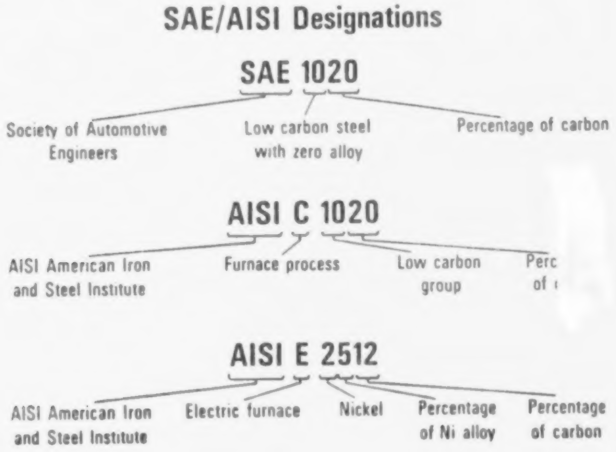
B. Processing methods are assigned AISI letters to assist with identification

1. A = Open-hearth alloy steel
2. B = Acid Bessemer carbon steel
3. C = Basic open-hearth carbon steel
4. D = Acid open-hearth carbon steel
5. E = Electric furnace steel

INFORMATION SHEET

C. The first digit of the number code indicates the type of alloy, the second digit indicates the percentage of that alloy, and the last two digits indicate the percentage of carbon in the steel (Figure 6)

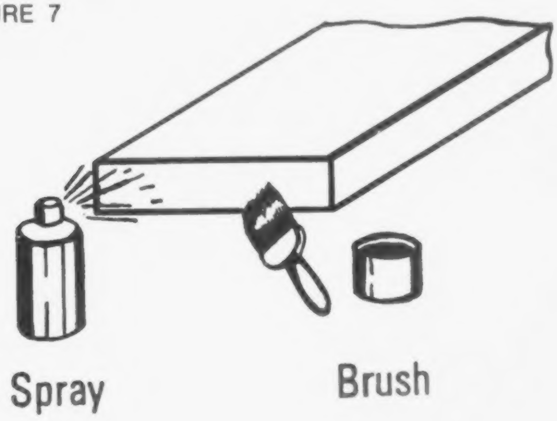
FIGURE 6


SAE/AISI Designations
SAE 1020
Society of Automotive Engineers
Low carbon steel with zero alloy
Percentage of carbon
AISI C 1020
AISI American Iron and Steel Institute
Furnace process
Low carbon group
Perc
of
AISI E 2512
AISI American Iron and Steel Institute
Electric furnace
Nickel
Percentage of Ni alloy
Percentage of carbon

D. Color coding — A color or colors are painted on the ends of steel bars or sheets to indicate the type of steel (Figure 7)

(NOTE: Color coding varies with each manufacturer, so identification requires a guide from the mill that produced the steel, and when working with color coded stock, start from the opposite end of the coloring so the stock can still be quickly identified even after part of it has been used.)

FIGURE 7


Spray
Brush

INFORMATION SHEET

E. UNS (Unified Numbering System) — A new system used by SAE and ASTM that uses a letter prefix with a five-digit number with the letter usually suggesting a general ferrous metal or alloy group

(NOTE: This new system has been proposed as an international system for identification of metals and alloys.)

Example:

Ferrous Metals

ID Letter and Number	General Metal or Alloy Group
000001-D99999	General Metal or Alloy Group
F00001-F99999	Cast iron, carbon and low-alloy steel castings
G00001-G99999	Carbon and alloy steels (AISI and SAE)
H00001-H99999	H steels (AISI)
K00001-K99999	Other steels and ferrous alloys
S00001-S99999	Stainless steels
T00001-T99999	Tool steels

XVIII. Carbon steel classifications, characteristics, and uses

Classification	Characteristics	Typical Uses
Low carbon	0.07% to 0.15% carbon	Nails, iron bars and rods, auto bodies, and pipes
Mild steel	0.15% to 0.25% carbon	Gears, shafts, bolts, metal frames, angles, and channels
Medium carbon	0.25% to 0.60% carbon	Axles, shafts, machine bolts, boilers, hammers, and sledges
High carbon	0.60% to 1.50% carbon	Screwdrivers, crow bars, axes, springs, razors, and fine cutters

INFORMATION SHEET

XIX. Alloy steel classifications, characteristics, and uses

Classification	Characteristics	Typical Uses
Nickel steel	Strong and hard, resists corrosion, withstands shocks, vibration, and wear	Wire cables, railroad and car axles, and steel rails
Chromium steel	Fine grain, tough and strong, resists corrosion, shocks, and scratches	Auto bearings and safes
High chromium steel (Stainless steel)	Does not corrode, has a bright, silvery finish that looks good	Sinks, tables, and food service items subject to high standards of cleanliness
Chrome-nickel steel	Hard and strong	Auto gears, springs, axles, and armor plate
Manganese steel	Tough and strong, can resist strain, shock, and hammering	Jaws of rock crushers, chains, gears, and safes
Molybdenum steel	Tough and strong, resists heat and impact wear	Auto parts, high-grade machinery, and roller bearings
Tungsten steel	Hard, fine grained, and resists heat	High-speed metal cutting tools
Tungsten steel (Magnet steel)	Holds magnetism well	Electrical measuring instruments
Tungsten steel (Tungsten carbide)	Hardest man-made metal	Cutting tools and dies
Vanadium steel	Tough, but lightweight, fine grained, and resists shock	Auto axles, gears, and springs
Stellite	Extremely hard	Heavy cutting tools
High-speed steel	Self-hardening steel	Cutting tools, taps, and drills

INFORMATION SHEET

XX. Iron classifications, characteristics, and uses

Classification	Characteristics	Typical Uses
Wrought iron	Resists corrosion, withstands shock, is malleable and easy to bend hot or cold	Rivets, bolts, nails, horseshoes, and ornamental iron
Gray cast iron	Relatively inexpensive, high compressive strength, but low tensile strength and brittle	Large pipes, stoves, water hydrants, and machinery frames
White cast iron	Very hard and brittle	Machine parts subjected to extreme wear or abrasion
Malleable cast iron	Tougher and more impact resistant than other cast irons	Farm tools, implement parts, and railroad equipment

XXI. Aluminum, its characteristics and uses

A. Aluminum is the most used and most abundant of the nonferrous metals

B. Aluminum is a silvery-white metal with a brilliant surface beauty that resists corrosion, and is maintenance free

C. Pure aluminum is very soft and difficult to use so it is usually combined with an alloy to change its characteristics

D. Aluminum is a good conductor of electricity, an excellent reflector of heat when it is polished, and a good thermal conductor

E. Aluminum is both malleable and ductile and can easily be formed into shapes or into wire

F. Aluminum is available in sheets, plates, bars, wires, pipes, and tubes

G. Aluminum is also available in a great number of extruded forms

XXII. AA system of identifying aluminum and aluminum alloys

A. Principal alloying ingredients are assigned numbers to assist with identification

1. Aluminum, 99% or more with no alloy

INFORMATION SHEET

2. Copper
3. Manganese
4. Silicon
5. Magnesium
6. Magnesium-silicon
7. Zinc
8. Other

B. The AA number code has a 1000 series (1000 to 1999) that is used only to identify unalloyed aluminum, and the first digit indicates a minimum of 99% aluminum

C. The second digit of the 1000 series indicates the degree of impurity control during manufacture, with 0 being the lowest control and 9 being the highest control

D. The third and fourth digits of the 1000 series indicate the aluminum purity in hundredths of a percent over 99%

Example: In the number 1030, the 1 indicates minimum 99% aluminum, the 0 indicates minimum control of impurities, the 30 indicates .30 percent beyond 99% or a product with 99.30% aluminum

E. All series beyond 1999 (2000 and beyond) are used only to identify aluminum alloys

F. The first digit of the upper series identifies the principal alloying element

G. The second digit indicates purity control

H. The third and fourth digits indicate the different types of alloys in the group

Example: In the number 2017, the 2 indicates that copper is the principal alloying element, the 0 indicates minimum purity control, and the 17 indicates it is only aluminum and copper with no other alloying element

INFORMATION SHEET

XXIII. The AA temper designation system for aluminum (Transparency 3)

A. The AA temper designation system is based on the basic treatments and processes used to produce different types of aluminum, and the temper designation always follows the alloy designation and is separated by a dash

Example: In the number 5083-H34, the 5083 is the alloy designation and the H34 is the temper designation

B. The basic temper designations and subdivisions are as follows:

1. F — As fabricated indicates products that have acquired some uncontrolled tempering during manufacture

2. O — Annealed indicates wrought products only, the softest temper

3. H — Strain-hardened indicates products that have had their strength increased by strain-hardening or cold working with no thermal treatment to produce partial softening

   (NOTE: H1, H2, H3, and all H designations indicate special strain-hardening processes.)

4. T — Thermally treated to produce stable tempers

   (NOTE: T1 through T10 indicate special treating and aging processes.)

C. Heat treatment gives strength tempers which are listed as the second digit after the letter H

D. Strength tempers are expressed on a base of 8 so that the number 2 would indicate 2/8 or 1/4 hard, the number 4 would indicate 4/8 or 1/2 hard, the number 6 would indicate 6/8 or 3/4 hard, and the number 8 would indicate 8/8 or full hard

(NOTE: The number 9 is also used to indicate 9/8 or extra hard.)

INFORMATION SHEET

E. UNS (Unified Numbering System) — A new system used by SAE and ASTM that uses a letter prefix with a five-digit number with the letter usually suggesting a general metal or alloy group

(NOTE: This new system has been proposed as an international system for identification of metals and alloys.)

Example:

Nonferrous Metals	
ID Letter and Number	General Metal or Alloy Group
A00001-A99999	Aluminum and aluminum alloys
C00001-C99999	Copper and copper alloys
E00001-E99999	Rare earth and similar metals
L00001-L99999	Low-melting point metals
M00001-M99999	Miscellaneous metals and alloys
N00001-N99999	Nickel and nickel alloys
P00001-P99999	Precious metals
R00001-R99999	Reactive metals

XXIV. Other aluminum abbreviations and their meanings (Figure 8)

A. AQ — Aircraft quality

B. CQ — Commercial quality

C. HTQ — High tensile quality

XXV. Steps in identifying aluminum

A. Determine number code series

B. Determine the principal alloying element

C. Determine the H or T designation

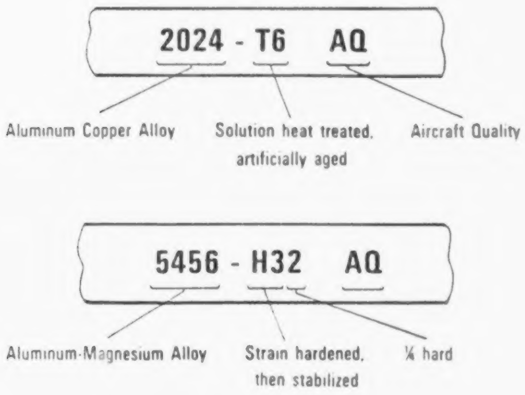
D. Determine the hardness percentage

INFORMATION SHEET

E. Determine the quality designation

FIGURE 8

Identification Markings


2024 - T6 AQ
Aluminum Copper Alloy
Solution heat treated, artificially aged
Aircraft Quality
5456 - H32 AQ
Aluminum-Magnesium Alloy
Strain hardened, then stabilized
¼ hard

XXVI. Chemical tests for identifying aluminum alloys

A. The copper, nickel, zinc test

1. Used to identify the more readily weldable alloys from the 2000 and 7000 series aluminum alloys
2. Consists of placing a drop of 20% sodium hydroxide on the surface of the alloy being tested only after oxides have been removed from the base metal surface
3. If a black spot forms in 1 to 5 minutes it indicates moderate to large amounts of copper, nickle, and zinc

(NOTE: Brown or gray spots may appear, but should be ignored.)

B. The manganese test

(CAUTION: This procedure produces toxic fumes.)

1. Used to identify the more readily weldable alloys 3003 and 3004 which contain 1 to 1.5% manganese
2. Consists of preheating the aluminum to about 200°F, placing a few drops of silver nitrate on the surface, then adding a few small crystals of ammonium presulfate
3. If the spot turns pink and stays pink as long as the aluminum is warm, it indicates a definite presence of manganese

INFORMATION SHEET

XXVII. Other nonferrous metals and typical uses

A. Copper — Used in electric and telephone wires, and alloyed with zinc or tin to form brass or bronze, and in industrial applications because it is the second best conductor of electricity

B. Zinc — Used to galvanize iron and steel for protection from rust

C. Magnesium — Used in everything from lawnmower engine blocks to space vehicles because it is lightweight

D. Nickel — Used primarily as an alloy to toughen steel

E. Titanium — Used in supersonic aircraft because of its high heat resistance and capacity to withstand vibration, and in petrochemical applications because of its high corrosion resistance

F. Beryllium — Used in the space program because of its light weight and high heat resistance

G. Gold — Used for jewelry, coins, and coating electrical devices, and usually alloyed with copper or nickel because it is too soft for general use

H. Lead — Used in auto batteries and alloyed with tin to make solder

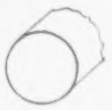
I. Silver — Used in coins, jewelry, tableware, and in industrial applications because it is the best conductor of electricity

J. Tin — Used for making tin cans, and used as an alloy to make bronze, babbitt, pewter, and solder

XXVIII. Standard metal shapes available for welding

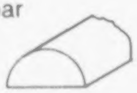
A. Round bar

Example:



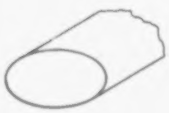
B. Half-round bar

Example:



C. Oval bar

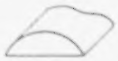
Example:



INFORMATION SHEET

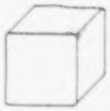
D. Half-oval bar

Example:



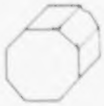
E. Square bar

Example:



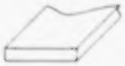
F. Hexagon bar

Example:



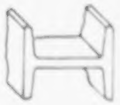
G. Flat bar

Example:



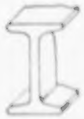
H. H beam

Example:



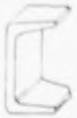
I. I beam

Example:



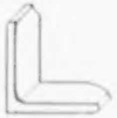
J. Channel

Example:



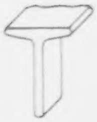
K. Angle

Example:

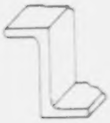


INFORMATION SHEET

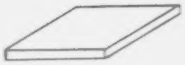
L. Tee

Example: 

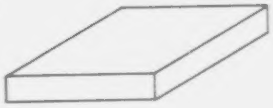
M. Zee

Example: 

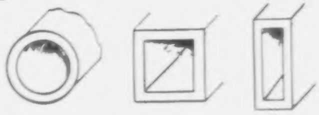
N. Flat sheet

Example: 

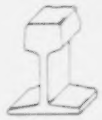
O. Flat plate

Example: 

P. Tubing and pipe

Example: 

Q. Rail

Example: 

XXIX. Equipment requirements for spark testing

A. Stationary or portable power grinder

B. A medium-grit grinding wheel such as 40 to 60 grit

C. A grinding wheel turning rate of 5,000 to 8,000 surface feet per minute

(NOTE: An ideal turning ratio can be accomplished with an 8-inch diameter wheel turning at 3,600 rpm, but wheels of larger diameters can easily be used with proper rpm adjustment.)

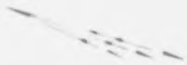
INFORMATION SHEET

D. A grinding wheel that has been dressed to remove traces of glazing or metal particles left from previous grinding

XXX. Terminology used in spark testing (Transparency 4)

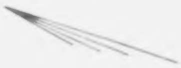
A. Arrow

Example:



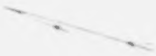
B. Shaft

Example:



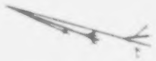
C. Fork

Example:



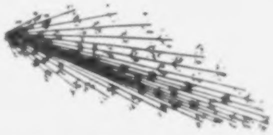
D. Sprigs

Example:



E. Stream

Example:



F. Color

1. Red color at grinding wheel usually indicates cast iron
2. Straw color at end of stream usually indicates cast iron
3. Straw or light orange color at grinding wheel usually indicates alloy steel
4. White color at grinding wheel usually indicates low or high carbon steel
5. Orange color usually indicates the presence of chromium

G. Volume of sparks

1. None for nonferrous metals
2. Small for gray cast iron and very small for white cast iron
3. Moderately large for low carbon steel
4. Large for high carbon steel
5. Moderate to large for stainless steel depending on type and amount of alloy

INFORMATION SHEET

H. Length is distance the spark pattern or stream travels from the grinding wheel

XXXI. Residual stresses and what they mean

A. Residual means "what is left at the end of a process," so, in welding, residual stresses refer to the forces and counterforces that leave stresses in a structure or part after a welding operation is completed

B. Residual stresses can produce shrinkage and other forms of distortion that make parts difficult or impossible to fitup

C. Residual stresses can produce in base metals structural and metallurgical changes so severe that a welded assembly could fail in service and damage property or hurt people

D. The presence of excessive residual stresses in a part or an assembly indicates that something in the welding procedure needs to be changed:

1. Joint design and fitup may need modification
2. The welding process itself may need modification
3. Filler metals or base metals may need modification
4. Thermal or mechanical controls may be needed to correct the problem
    a. Thermal controls include preheating, interpass heating, and post heating
    b. Mechanical controls include C-clamps, strongbacks, wedges, and many types of restraining jigs and fixtures

XXXII. Causes of residual stresses and distortion

A. Filler metals and base metals in a welding procedure have to be heated to a melting point or near melting point, and as they are heated, they expand, but not uniformly

B. During and after the welding operation, filler metals and base metals contract as they cool, but not uniformly

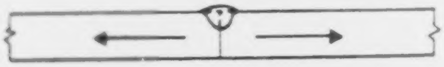
C. This lack of uniformity in expansion and contraction means that residual stresses will vary with joint design, welding procedure, and metal type and thickness, and the thicker the metals, the more problems with residual stresses

D. Once heat is applied, it has to go somewhere, and the ways heat escapes from a weld can be a clue to controlling residual stresses

INFORMATION SHEET

E. In a normal butt weld, heat escapes outward in both directions from the joint (Figure 9)

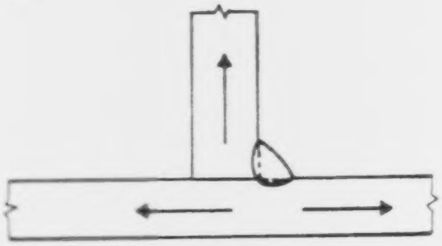
FIGURE 9



Courtesy Lincoln Electric Company

F. In a normal fillet weld, heat escapes outward from the sides and upward from the top (Figure 10)

FIGURE 10

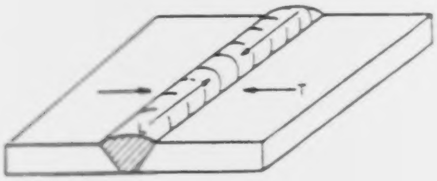


Courtesy Lincoln Electric Company

G. In a butt weld, the first passes can produce distortion *down* the length of the weld bead, and this is called longitudinal stress (Figure 11)

H. As the first passes of a butt weld solidify, the movement *across* the weld bead is also restricted, and this is called transverse stress (Figure 11)

FIGURE 11

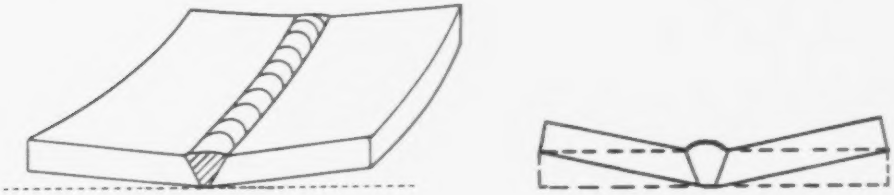


Courtesy Lincoln Electric Company

INFORMATION SHEET

I. The combination of longitudinal and transverse stresses in a butt weld result in distortion that usually causes the plates to rise from a flat or even position to a slight angle (Figure 12)

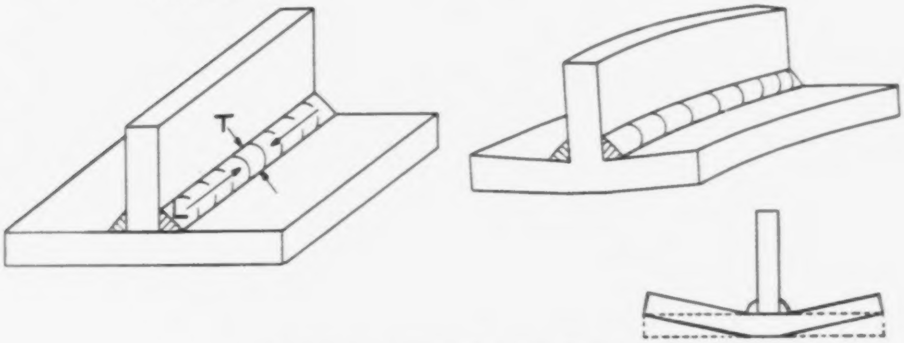
FIGURE 12



Courtesy Lincoln Electric Company

J. In a fillet weld, the combination of longitudinal and transverse stresses not only causes a change from flat to a slight angle, but can produce a roll or twist along the length of the parts (Figure 13)

FIGURE 13



Courtesy Lincoln Electric Company

XXXIII. Heat applications and their uses in weld quality control

A. Preheat — Heating a part before the welding process starts to help control cracking, stresses from shrinkage, and to promote a slower cooling rate to prevent excessive hardening

B. Interpass heat — Heating between welding passes to maintain the preheat temperature

(NOTE: The welding process itself will usually provide sufficient interpass heat, but on large assemblies, heating with a torch between passes is required to maintain proper welding temperatures.)

INFORMATION SHEET

C. Postheat — Heating a part after the welding process and allowing it to cool slowly to promote stress relief in the weldment and the base metal

XXXIV. Situations where preheating is usually required

A. When large or bulky parts are being welded or when parts being welded have a complicated shape

B. When the atmospheric temperature is cold or the temperature of the parts is cold

C. When the carbon or alloy content of steel is high

D. When the welding speed is fast

E. When small-diameter welding rods are used

XXXV. Methods of preheating and postheating

A. Furnaces

B. Electrical strip heaters clamped parallel to joints about 6" from the seam

C. Acetylene, propane, or oil torches used singly or in banks of two or more

D. Torch heating using natural gas with compressed air using a single-orifice heating tip the same size that would be used to oxyacetylene weld the joint

(NOTE: This method is used frequently in shop work because it gives a hot flame that burns clean and helps avoid contaminating the weld zone.)

E. Torch heating using multiflame heads or rosebuds

XXXVI. Torch preheating techniques and their applications

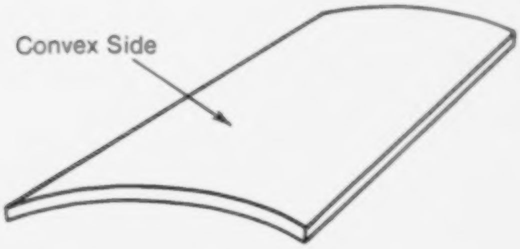
A. Spot heating — Heat applied at one specific point so that cooling will cause a slight inward movement around the point and help control nondirectional distortion

B. Slot heating — Heat applied along a seam or perpendicular to a seam to control directional distortion

INFORMATION SHEET

C. Convex heating — Since the side where heat is applied will always shorten more than the other side, spot and slot heating should be applied on the convex side when attempting to flatten plates (Figure 14)

FIGURE 14



XXXVII. Types of steels and their recommended preheat temperatures

A. Mild steels — Preheating is not normally required, but if temperature is below 50°F, preheat to about 100°F or higher if the plate thickness is over 1"

B. Medium carbon steels — Preheat from 200°F to 400°F, retain the same interpass temperature, and postheat is recommended, especially on thicker sections

C. High carbon steels — Preheat and interpass temperatures should be a minimum of 400°F, and postheat is recommended, especially on thicker sections

XXXVIII. Temperature-sensing devices and their uses

A. Pyrometers — Portable thermometers specifically designed to measure surface heat

B. Thermocouples — Temperature-sensing devices that may be attached to the work, but more often used in heating ovens and postweld heat treatment

C. Crayons and pellets — Temperature-sensing devices that melt suddenly when the work reaches a specific temperature

(NOTE: Crayons are usually color-coded for specific temperatures, and are frequently used in pairs to indicate a low and high range of heating so desired temperatures can be more accurately determined.)

INFORMATION SHEET

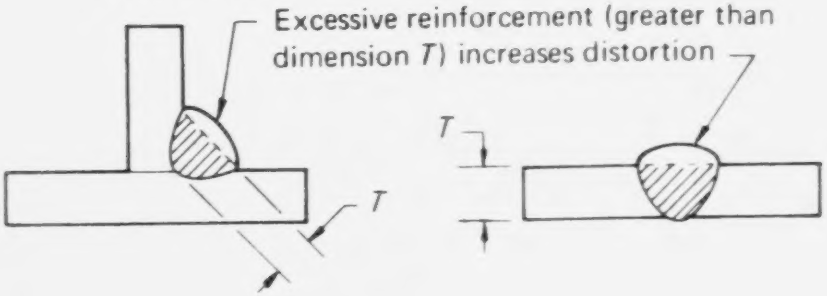
XXXIX. Ways to control distortion in welding

A. Do not overweld (Figure 15)

1. The more metal placed in a joint, the greater the shrinkage forces

2. Excess weld metal does not increase weld strength, but it does increase shrinkage forces

FIGURE 15


Excessive reinforcement (greater than dimension T) increases distortion
T
T

Courtesy Lincoln Electric Company

B. Modify edge preparation and fitup when butt welding thicker metals (Figure 16)

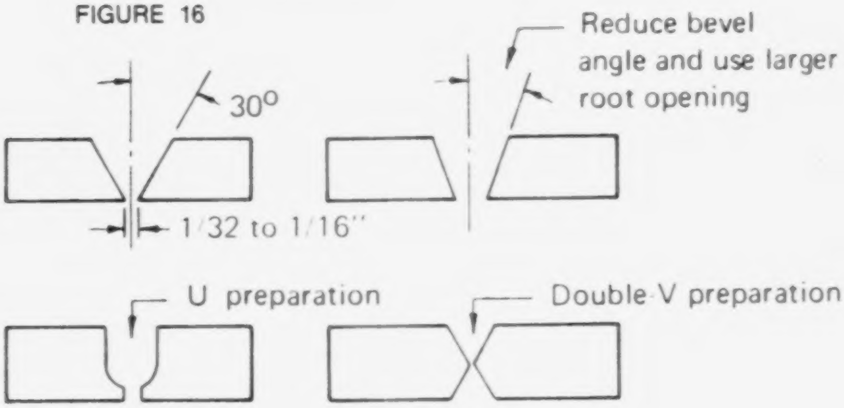
1. Plates for butt welds on thinner metals provide good fusion and require minimum weld metal with a 30° bevel on each side with plates spaced 1/32" to 1/16" apart

2. For thicker plates, decrease the bevel angle and increase the root opening or use a J or U joint design

INFORMATION SHEET

3. A double V-joint requires about half the weld metal of a single V-joint for the same plate thickness

FIGURE 16

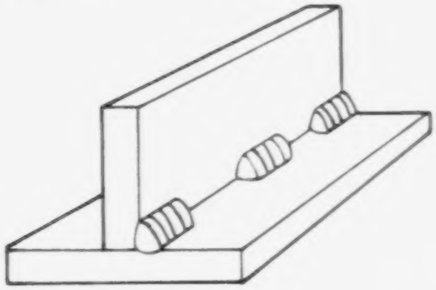

30°
1/32 to 1/16"
Reduce bevel angle and use larger root opening
U preparation
Double-V preparation

Courtesy Lincoln Electric Company

C. Use intermittent welding (Figure 17)

1. Intermittent welds provide needed strength
2. Intermittent welds reduce the amount of weld metal required

FIGURE 17



Courtesy Lincoln Electric Company

D. Use as few passes as required (Figure 18)

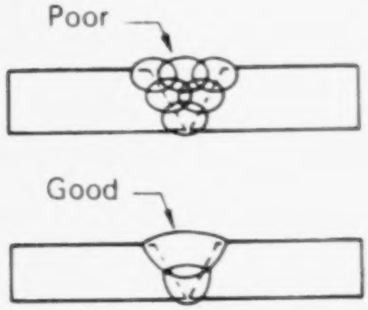
1. Each pass increases the possibility for increased shrinkage

INFORMATION SHEET

2. Fewer passes with larger electrodes are better than more passes with smaller electrodes

   (NOTE: Suggestions about fewer passes apply only to situations where fewer passes would not violate specifications.)

   FIGURE 18



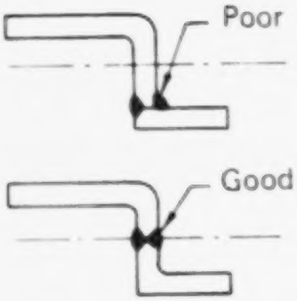
Courtesy Lincoln Electric Company

E. Place welds near a neutral axis (Figure 19)

   1. Weld design and weld sequence can both help control shrinkage

   2. Welding at or along a neutral axis gives less leverage to forces that cause distortion

   FIGURE 19



Courtesy Lincoln Electric Company

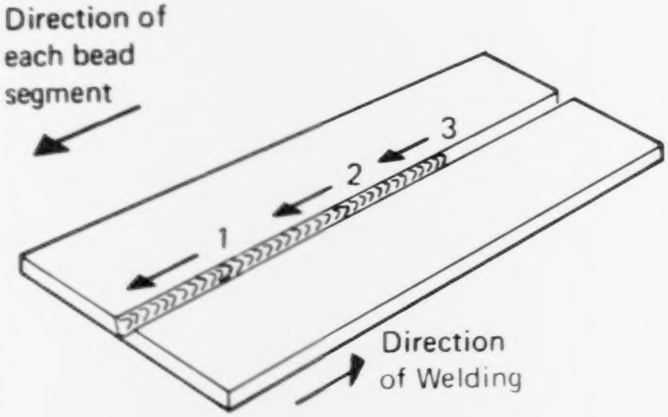
F. Use backstep welding (Figure 20)

   1. Direction of welding is usually left to right, but beads deposited from right to left so that heat will spread uniformly to outer edges should bring plates back in alignment

INFORMATION SHEET

2. Not an economical procedure for automatic welding

FIGURE 20


Direction of each bead segment
1
2
3
Direction of Welding

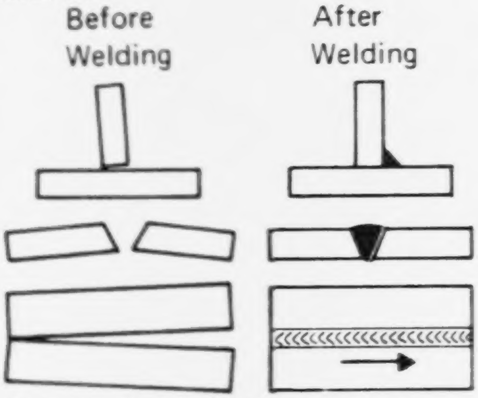
Courtesy Lincoln Electric Company

G. Preset parts to take advantage of shrinkage (Figure 21)

1. Anticipate the places of shrinkage and amount of shrinkage and position parts so that they will be pulled into alignment during welding

2. The process requires good estimating, but a few trial welds should indicate how to preset the parts

FIGURE 21


Before Welding
After Welding

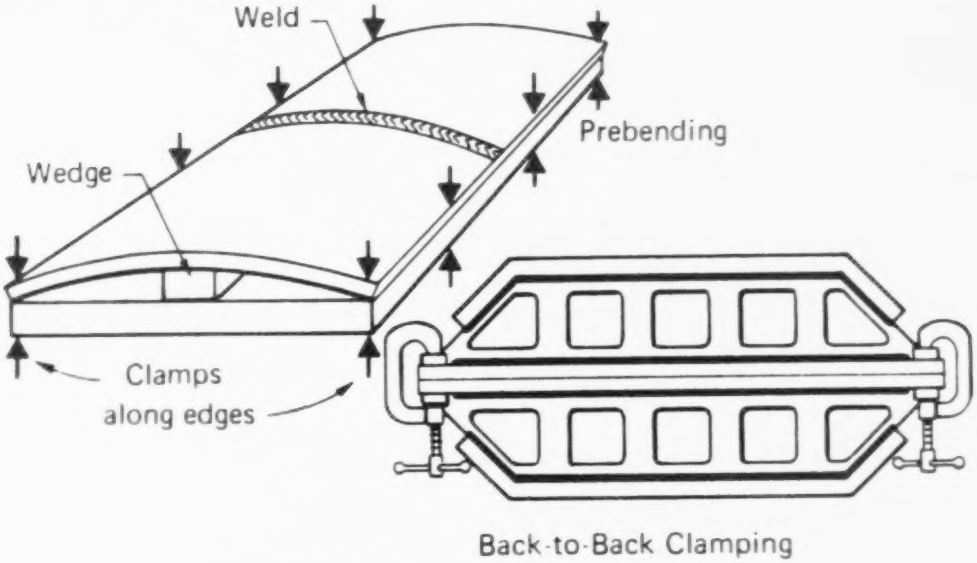
Courtesy Lincoln Electric Company

INFORMATION SHEET

H. Prebend and clamp parts or clamp parts back to back (Figure 22)

1. Prebending actually makes the joint longer so that shrinkage will cause the joint to be flat as the plate cools and the clamps are released
2. Clamping similar parts back to back helps distortion forces work against each other to control shrinkage

FIGURE 22


Weld
Prebending
Wedge
Clamps
along edges
Back-to-Back Clamping

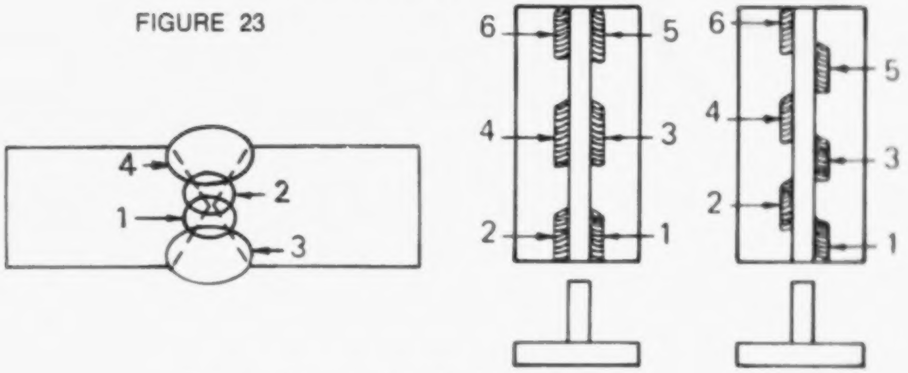
Courtesy Lincoln Electric Company

I. Weld in a logical sequence (Figure 23)

1. Weld at different points in the assembly so that as the part shrinks in one place it counteracts the shrinkage forces of welds already made

2. Alternate sides on fillet welds and use intermittent welding so that shrinkage in the first weld is counterbalanced by shrinkage in the second weld, shrinkage in the second weld is counterbalanced by shrinkage in the third weld, etc.

FIGURE 23

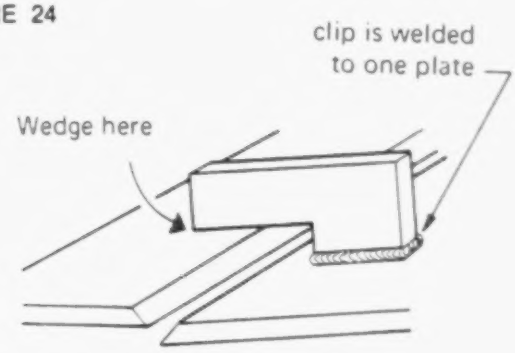


Courtesy Lincoln Electric Company

XL. Ways to control distortion with restraining devices

A. When butt welding plates, tack weld clips along the edge of one plate, then drive wedges under the open side of the clip to force the edges into alignment (Figure 24)

FIGURE 24



Courtesy Lincoln Electric Company

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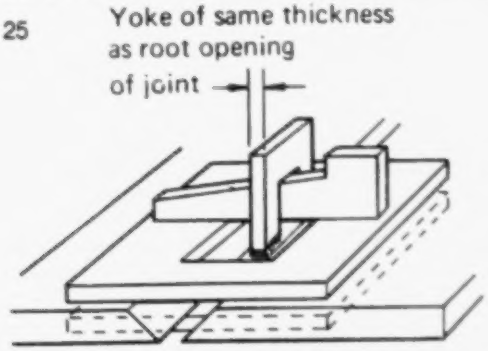
B. Tack weld a yoke to a backup strip, slip the yoke between the edges, then place a guide yoke on top of the plates and drive a wedge through the first yoke to align the plates (Figure 25)

(NOTE: When the thickness of the yoke is the same as the root opening, it can be moved along to serve as a spacer between the edges.)

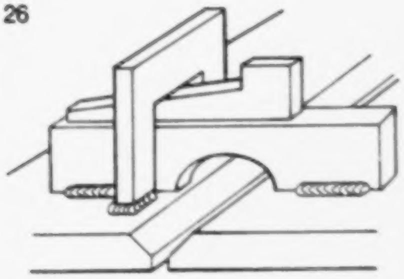
FIGURE 25



Courtesy Lincoln Electric Company

C. For butt welds on thicker plates, tack weld a yoke on top of one plate, a bar to the top of the second plate, then drive a wedge between the yoke and the bar (Figure 26)

FIGURE 26



Courtesy Lincoln Electric Company

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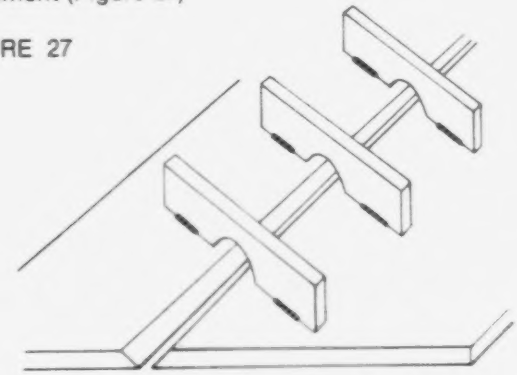
D. When there is a possibility that the use of several strongbacks would restrain the weld so much that it would produce cracking as the weld cools, position the strongbacks at a 45° angle across the joint to allow transverse movement (Figure 27)

FIGURE 27



Courtesy Lincoln Electric Company

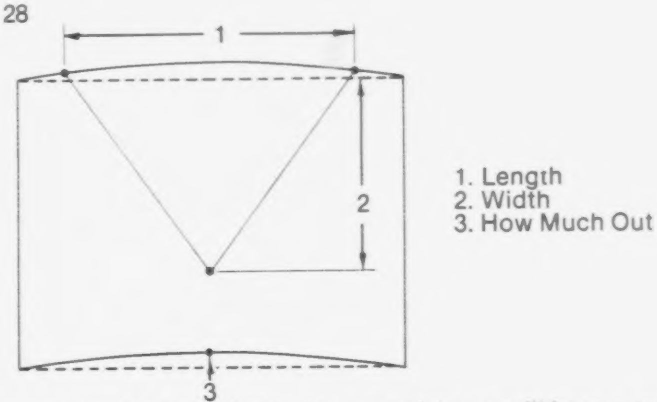
XLI. Guidelines for correcting distortion in welded components (Figure 28)

A. Determine width of distortion at maximum point

B. Determine length of distortion

C. Determine out of tolerance distortion in inches or fractions of an inch

FIGURE 28



D. Sketch dimensions (as indicated in the example) so you'll have a record to use as a work reference

XLII. Procedure for straightening a distorted steel member (Figure 29)

A. Determine dimensions of needed correction (as previously outlined)

B. Mark work area and dimensions with a soapstone so that point C is situated from point A a distance equal to one third the width of the member

INFORMATION SHEET

C. Start heat at point C with flame pointing toward point B

(NOTE: Flame angle must be toward point B in order to keep point A as cool as possible in order to cause point C to "upset" or expand into itself.)

D. Heat point C to a light red, but not enough to melt the surface

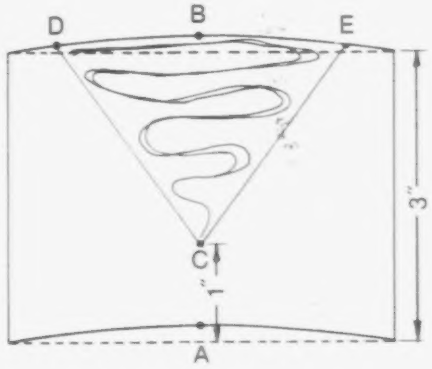
E. As point C turns a light red, move the flame slowly toward point B as you widen the heating pattern by moving the torch in a circular motion toward the extremes of the out-of-tolerance dimensions of points D and E

F. As the flame moves from point C, the metal at that point cools and "upsets" or expands into itself

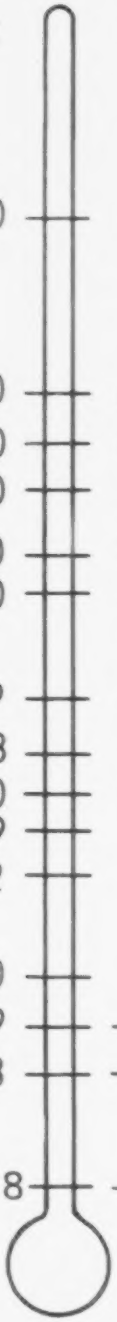
G. The widening heat pattern plus the cooling and contraction of the metal behind it will cause the edge at B to stretch at first, but then it will contract on cooling and serve to straighten the member

(NOTE: The secret for successfully completing this procedure is to keep point A as cool as possible so it acts as a hinge around which the out-of-tolerance points can move, and when properly executed, this procedure is so effective that it can be used in many applications safely, even on steel bridge members.)

FIGURE 29



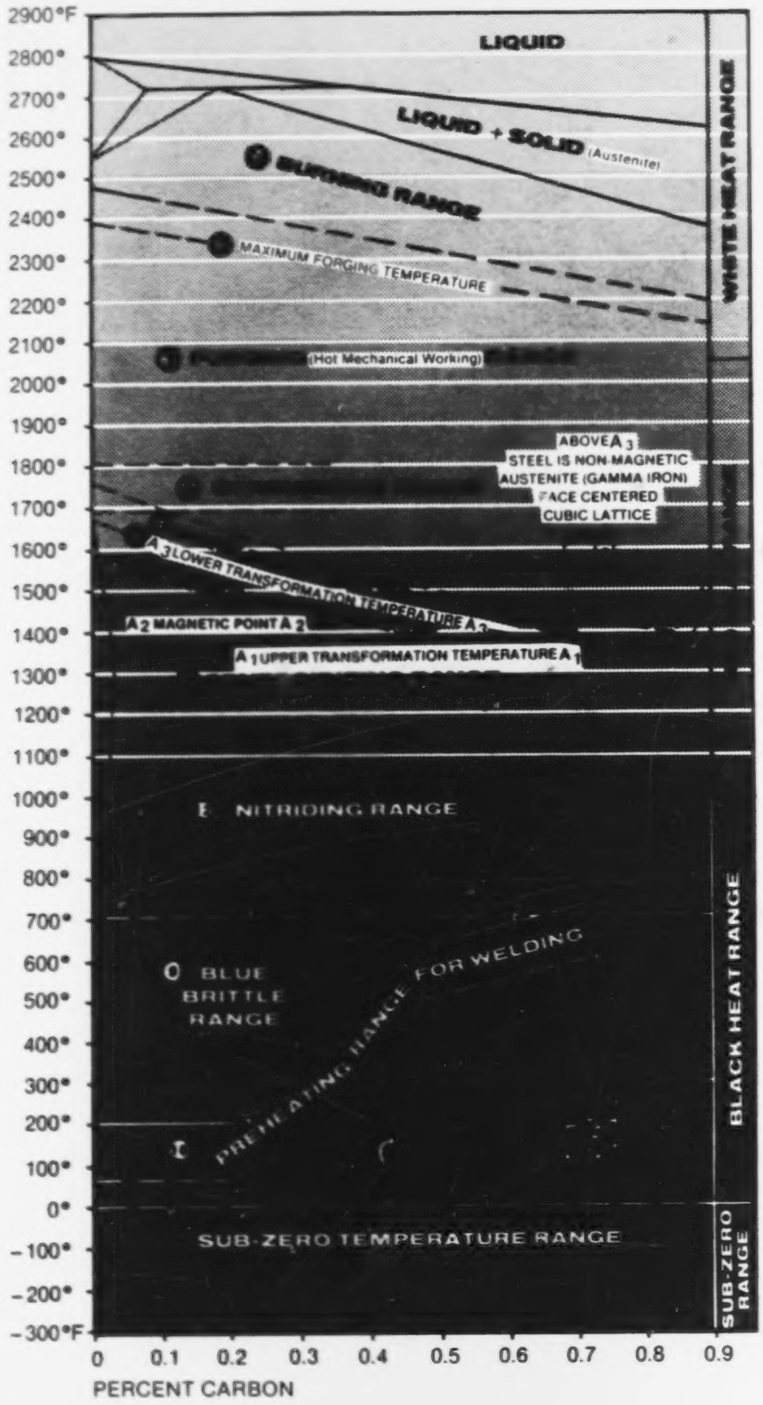
Metal Melting Points and Other Temperatures



°C	°F	
6020	10,900	Welding arc
3500	6330	Oxyacetylene flame
3410	6170	Tungsten melts
2800	5070	Oxyhydrogen flame
1890	3430	Chromium melts
1870	3360	Natural gas burner
1539	2802	Iron melts
1083	1981	Copper melts
660	1220	Aluminum melts
419	787	Zinc melts
232	449	Tin melts
0	32	Ice melts
–39	–38	Mercury melts
–78	–110	Dry ice vaporizes
–273.18	– 459.72	Absolute zero

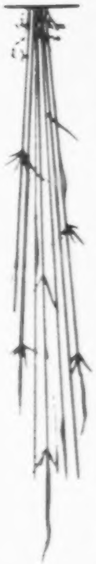
Courtesy Lincoln Electric Company

Heating Ranges for Ferrous Metals



Spark Test Characteristics

Low-Carbon Steel



Color-white

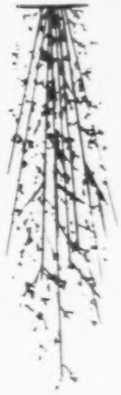
Average length of stream with power grinder - 70 in.

Volume -moderately large

Shafts shorter than wrought iron and in forks and appendages

Forks become more numerous and sprigs appear as carbon content increases

High-Carbon Steel



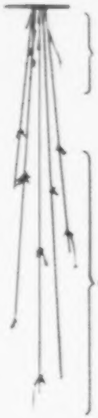
Color -white

Average stream length with power grinder - 55 in.

Volume -large

Numerous small and repeating sprigs

Stainless and Other Alloy Steel



Color -straw yellow

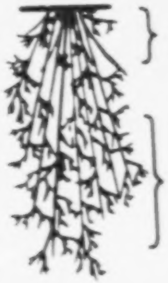
Stream length varies with type and amount of alloy content

Shafts may end in forks, buds or arrows, frequently with break between shaft and arrow. Few, if any, sprigs

Color - white

Spark Test Characteristics
(Continued)

White Cast Iron



Color - red

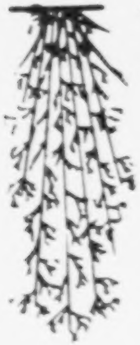
Color - straw yellow

Average stream length with power grinder - 20 in.

Volume - very small

Sprigs - finer than gray iron, small and repeating

Gray Cast Iron



Color - red

Color - straw yellow

Average stream length with power grinder - 25 in.

Volume - small

Many sprigs, small and repeating

Aluminum Hardness and Tempering Designations

T#	Process	Applications
T1	Naturally aged to a substantially stable condition	Castings which have their strength increased by room-temperature aging from the as-cast condition
T2	Annealed cast products only	Castings which have their ductility improved and dimensional stability increased with an annealing treatment
T3	Solution heat-treated and then cold worked	Products cold worked to improve strength or to achieve the effect of cold work in flattening or straightening
T4	Solution heat-treated and naturally aged to a substantially stable condition	Products which are not cold worked after solution heat-treatment
T5	Artificially aged from the as-cast condition	Products which are aged at elevated temperatures from the as-cast condition to improve mechanical properties or dimensional stability or both
T6	Solution heat-treated and then artificially aged	Products which are not cold worked after solution heat-treatment
T7	Solution heat-treated and then stabilized	Products which are stabilized to carry them beyond the point of maximum strength to provide control of special characteristics
T8	Solution heat-treated, cold worked, then artificially aged	Products which are cold worked to improve strength for certain applications
T9	Solution heat-treated, artificially aged, and then cold worked	Products which are cold worked to improve strength for certain applications
T10	Artificially aged and then cold worked	Products which are artificially aged after an elevated-temperature, rapid-cool process, and then cold worked to improve strength

BASIC METALS AND METALLURGY
UNIT IV

ASSIGNMENT SHEET #1 — IDENTIFY SELECTED METALS BY APPEARANCE, COLOR, AND CORROSION CHARACTERISTICS

Directions: Your instructor has tagged a group of metals with numbers. Name each metal by evaluating its appearance, color, or any corrosion characteristics you can detect with your eye, then enter the name of the metal in the appropriate space below.

Metal #1: ____________________

Metal #2: ____________________

Metal #3: ____________________

Metal #4: ____________________

Metal #5: ____________________

Metal #6: ____________________

Metal #7: ____________________

(NOTE: Your instructor may include other metals. In that case, extend your list as required.)

BASIC METALS AND METALLURGY
UNIT IV

ASSIGNMENT SHEET #2 — IDENTIFY METAL SHAPES USED FOR WELDING

Directions: Your instructor has tagged a group of metals with numbers. Identify the shape of each piece of metal and enter the name of the shape in the appropriate space below.

Shape #1: ______________________________

Shape #2: ______________________________

Shape #3: ______________________________

Shape #4: ______________________________

Shape #5: ______________________________

Shape #6: ______________________________

Shape #7: ______________________________

Shape #8: ______________________________

Shape #9: ______________________________

Shape #10: ______________________________

Shape #11: ______________________________

Shape #12: ______________________________

Shape #13: ______________________________

Shape #14: ______________________________

Shape #15: ______________________________

(NOTE: Your instructor may include other shapes. In that case, extend your list as required.)

BASIC METALS AND METALLURGY
UNIT IV

ASSIGNMENT SHEET #3 — PREPARE A WORKING REFERENCE FOR STRAIGHTENING A DISTORTED STEEL MEMBER

Directions: Use a pencil and a rule to measure and mark on the following illustration the critical heating points and pattern for straightening an out-of-tolerance steel member, based on the following information:

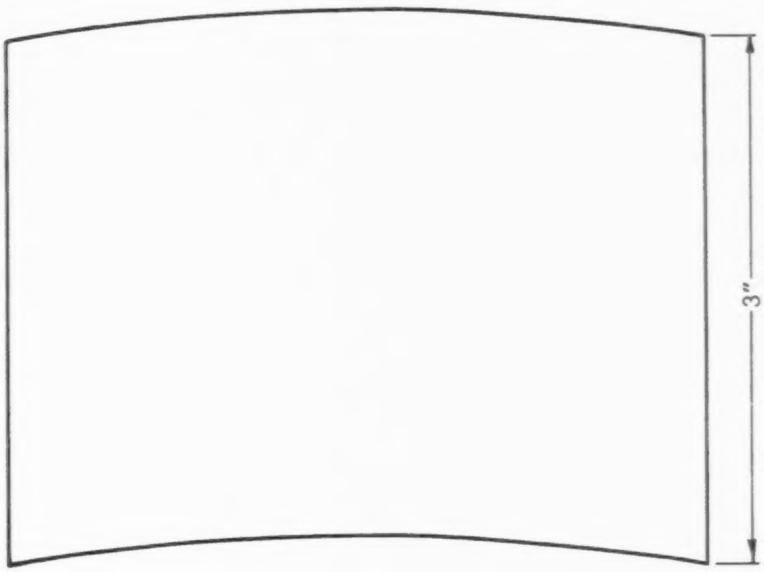
A. The steel member is 3" wide

B. The width of the distortion at maximum point is 3"

C. The length of distortion is 2"

D. The maximum distortion is at the top of the member (as shown) and near the center of the span

E. All critical points should be labeled with a letter and the heating pattern should be sketched in as a working reference



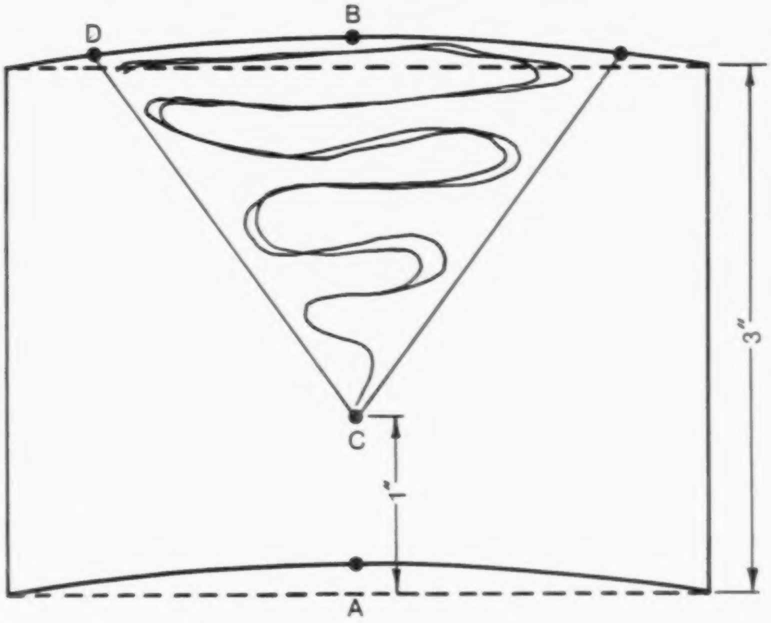
BASIC METALS AND METALLURGY
UNIT IV

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1 and #2 evaluated to the satisfaction of the instructor

Assignment Sheet #3

(NOTE: Sketch should approximate lettering of critical heating points and heating pattern as shown, and distance from point A to point C should be 1" ± 1/16".)



BASIC METALS AND METALLURGY
UNIT IV

JOB SHEET #1 — CONDUCT MAGNET TESTS TO IDENTIFY COMMON METALS USED FOR WELDING

I. Tools and materials

  A. Safety glasses

  B. Hand-held magnet

  C. Metal samples as selected by instructor

II. Procedure

  A. Place metal sample #1 on a wooden or nonmagnetic workspace

  B. Place the magnet on the metal sample

  C. Observe whether or not the magnet sticks to the metal sample

  D. Stop and record your findings on the magnet test chart

  E. Repeat the procedure for each of the metal samples

  F. Complete your magnet test chart and turn it in to your instructor for evaluation

  G. Clean up work area and return tools and materials to proper storage area

JOB SHEET #1

Metal Sample #	Magnetic (Ferrous)	Nonmagnetic (Nonferrous)
1		
2		
3		
4		
5		

BASIC METALS AND METALLURGY
UNIT IV

JOB SHEET #2 — CONDUCT SPARK TESTS TO IDENTIFY COMMON METALS USED FOR WELDING

I. Tools and materials

A. Safety glasses

B. Face shield

C. Locking pliers

D. Pedestal grinder

E. Metal samples as selected by instructor

II. Procedure

A. Check the work area for safe working conditions

B. Provide as dark a back-drop as is available to assist with better spark recognition

C. Check grinder for proper working order

D. Check grinding wheel to make sure it has been dressed

E. Turn off light on grinder if there is one

F. Put on face shield

G. Lock pliers onto first metal sample

H. Turn on grinder and allow it to reach maximum rpm

I. Position yourself at the grinder so that all sparks will be free of obstructions and easy to observe

J. Place metal sample on tool rest, hold pliers tightly, and move metal into grinding wheel until it makes light contact

K. Grind metal sample long enough to produce a stable spark pattern

L. Observe color close to wheel and color of sparks at the dying end of the spark stream

M. Observe the shape of the spark pattern or stream pattern

N. Observe the volume and length of spark stream

JOB SHEET #2

O. Remove metal sample and turn grinder off

P. Record your findings on the spark test identification chart

Q. Repeat the set-up, testing, and recording procedure for metal samples #2, #3, #4, and #5

R. Complete spark test identification chart and turn it in to your instructor for evaluation

S. Secure all equipment, clean up work area, and return tools and materials to proper storage area

JOB SHEET #2

Metal Sample #	Color	Pattern Shape	Volume	Length in Inches	Name of Metal
1	At wheel: End Stream:				
2	At wheel: End Stream:				
3	At wheel: End Stream:				
4	At wheel: End Stream:				
5	At wheel: End Stream:				

BASIC METALS AND METALLURGY
UNIT IV

JOB SHEET #3 — CONDUCT CHISEL TESTS TO IDENTIFY COMMON METALS USED FOR WELDING

I. Tools and materials

- A. Safety glasses
- B. Cold chisel
- C. Hammer
- D. Vise
- E. Numbered metal samples as selected by instructor

II. Procedure

- A. Put on safety glasses and face shield
- B. Secure metal sample #1 in a vise
- C. Select a starting point that will provide a sufficient working distance along the workpiece
- D. Place the chisel at a 30° to 40° angle over the workpiece and strike the chisel head firmly with a hammer
- E. Strike the chisel as many times as required to establish whether it's easy or difficult to chip the metal and record this information on the Chisel Test Chart
- F. Determine whether the metal chips are continuous, small particles, or if there are no chips at all and record this information on the Chisel Test Chart
- G. Determine whether the chip or chips have smooth or rough edges and record this information on the Chisel Test Chart
- H. Repeat the above procedure for all metal samples provided by the instructor
- I. Complete your Chisel Test Chart and turn it in to your instructor for evaluation
- J. Clean up area and return tools and materials to proper storage area

JOB SHEET #3

Metal Sample #	Degree of Chipping Difficulty	Size of Chips	Appearance of Chips	Name of Metal
1				
2				
3				
4				
5				

BASIC METALS AND METALLURGY
UNIT IV

NAME ____________________

TEST

(NOTE: Because of the length of this test, your instructor may spread it out over two or three test periods.)

1. Match the terms on the right with their correct definitions.

_____a. The science of separating metals from their ores and smelting or refining them for use

_____b. Metals added in making a brazed, welded, or soldered joint

_____c. Application of heat to a base metal before welding or cutting

_____d. Application of heat to a base metal during a welding process

_____e. Application of heat to welding or a weldment after a welding or cutting operation to promote a slower cooling rate and relieve stresses in the base metal and the weldment

_____f. Assembly of two or more metal parts with welding

_____g. Two or more metals that have properties that can readily be welded

_____h. American Iron and Steel Institute

_____i. Society of Automotive Engineers

_____j. The process of forcing a heated metal through a special form to give it shape and length

_____k. Aluminum Association

_____l. A metal that has had its strength increased without or with minimum thermal treatment

1. Weldment
2. Compatibility
3. Metallurgy
4. Postheating
5. Strain-hardened
6. AISI
7. Filler metals
8. SAE
9. Preheating
10. AA
11. Interpass heating
12. Extruding

TEST

2. Complete the following list of reasons for proper metal identification by inserting the word(s) that best completes each statement.

   a. Determines selection of ______________ metals

   b. Determines preheat, ______________, or postheat requirements

   c. Determines welding ______________

   d. Determines ______________ of metals

3. Complete definitions of basic categories of metals by inserting the word(s) that best complete each statement.

   a. Ferrous — Metals that contain ______________ as a major element

   b. Nonferrous — Metals that contain ______ ______________ or extremely small amounts of ______________

4. Complete definitions of alloys and their characteristics by inserting the word(s) that best complete each statement.

   a. Alloy — A metal formed by melting, fusing, or mixing ______________ or more metals together

   b. Alloy steels — Steels with ______________ or more other metals added to give the steels certain characteristics or properties

5. Match tests for metal identification with their procedures.

______a. This device will stick to ferritic alloys, but it will not stick to nonferritic alloys

______b. Nonferrous metals can usually be worked easily, and ferrous metals are more difficult to work

______c. Ferrous metals have definite patterns, and nonferrous metals have no patterns

______d. Certain of these agents or acids applied to metals cause different reactions

______e. General surface appearance, color, and the presence of oxidation

______f. When struck with a hammer, most metals have a characteristic ring or lack of it

______g. When chipped, certain metals produce a continuous chip, others break up into small particles, and others cannot be chipped

1. Spark
2. Chisel
3. Sound
4. Magnet
5. File
6. Chemical
7. Appearance

TEST

6. Complete a list of two basic elements of metallurgy by inserting the word(s) that best completes each statement.

   a. ______________ properties of metals

   b. ______________ properties of metals

7. Match mechanical properties of metals with their characteristics.

   _____a. The capacity of a metal to resist penetration, abrasion, and deformation

   _____b. The capacity of a metal to resist changing its shape or size when exposed to external forces

   _____c. The capacity of a metal to be permanently stretched without breaking

   _____d. The capacity of a metal to be hammered or rolled into shape without breaking

   _____e. The tendency of certain metals to break or fracture if bent or struck sharply

   _____f. The capacity of a metal to return to its original size and shape when the force that changed it is removed

   _____g. The incapacity of a metal to return to its original size and shape when the force that changed it is removed

   _____h. The tendency of some metals to break or fracture under a repeated or sustained load

   _____i. The capacity of a metal to absorb the impact of a load applied rapidly without failure

   _____j. The measure of ductility of material measured in a tension test

   1. Elongation
   2. Hardness
   3. Impact resistance
   4. Strength
   5. Fatigue
   6. Ductility
   7. Plasticity
   8. Malleability
   9. Elasticity
   10. Brittleness

TEST

8. Match types of mechanical strengths of metals with their meanings.

_____a. The capacity of a metal to resist being pulled apart

_____b. The capacity of a metal to resist being pushed or crushed together

_____c. The capacity of a metal to withstand a sustained load across its cross section

_____d. The capacity of a metal to resist twisting forces

1. Compressive strength
2. Shear strength
3. Tensile strength
4. Torsional strength

9. Match physical properties of metals with their characteristics

_____a. The weight of a given piece of metal in relation to a unit size such as one cubic foot

_____b. The capacity of a metal to conduct electrical current

_____c. The capacity of a metal to conduct heat

_____d. The tendency of metals to expand when heated as expressed in terms of coefficient of expansion

_____e. The point to which a metal must be heated before it will melt

1. Density
2. Electrical conductivity
3. Thermal conductivity
4. Thermal expansion
5. Melting point

10. Complete statements concerning the sub-zero temperature range and its effects on ferrous metals by circling the word(s) that best complete each statement.

a. Range extends from 0°F to (−300°F) (−500°F)

b. Almost all metals in this range have a (higher) (lower) impact resistance, and the lower the temperature, the (higher) (lower) the impact resistance

11. Complete statements concerning the black heat range and its effects on ferrous metals by circling the word(s) that best completes each statement.

a. Range extends from 0°F to (1000°F) (500°F)

b. Includes the preheating range for welding which runs from about 60°F to just above (700°F) (400°F)

TEST

c. Includes blue brittle range from 300°F to 700°F, a range at which peening or working of steels should not be done since those metals are (softer) (more brittle) at this range than above or below it

d. Includes the nitriding range from about 950°F to 1000°F, a range at which certain special steels are subjected to ammonia gas for long periods to give them (extremely hard skin) (extremely ductile skin) as the metal absorbs nitrogen

12. Complete statements concerning the red heat range and its effects on ferrous metals by circling the word(s) that best completes each statement.

    a. Range extends from 1000°F to (1500°F) (2050°F)

    b. Includes the stress relieving range which runs from about 1120°F to 1250°F, a range where temperatures are held long enough to relieve locked-up stresses, then the metal is (slowly) (rapidly) cooled to produce what is called process annealing

    c. Includes the spheroidizing range from about 1250°F to 1350°F, a range where temperatures are held long enough to produce a (hardness) (softness) that usually provides good machinability

    d. Includes the transformation range from about 1350°F to 1690°F, a range at which steels undergo (a change in atomic arrangements) (a softening period) which radically affect their properties

    e. Includes the annealing and normalizing range from about 1400°F to 1750°F, a range where temperatures are held long enough to form austenite, then (rapidly) (slowly) cooled to produce small grain size, softness, and good ductility

    f. Includes the carburizing range from about 1600°F to 1810°F, a range where carbon is dissolved into the surface of steel in the presence of carburizing compounds or gas mixtures to create (hard, high-carbon steel) (stainless steel)

    g. Includes forging range from about 1810°F to 2400°F, a range where metals (cannot be) (can be) mechanically worked or fused together

13. Complete statements concerning the white heat range and its effects on ferrous metals by circling the word(s) that best completes each statement.

    a. Range extends from 2050°F to (2900°F) (2500°F)

    b. Includes maximum forging temperature at (2400°F) (2100°F)

    c. Includes a transitional range where forging can no longer be done and (melting) (burning) begins

TEST

d. Includes a burning range from about 2490°F to 2550°F, a range at which steel is ruined and cannot be used again unless (remelted) (cooled rapidly)

e. Includes a range above the burning range, up to 2900°F, at which steels become (liquid) (extremely malleable)

14. Select true statements concerning ways of testing properties of metals by placing an "X" in the appropriate blanks.

______a. Brinell or Rockwell test for hardness

______b. Shore scleroscope test for hardness

______c. Hydraulic tests for tensile strength and ductility

______d. Izod-Charpy test for hardness

15. Match principal alloying agents of steel with their characteristics.

______a. A grayish-white, hard metallic element used instead of carbon to make special steels that are less brittle but harder than other steels with the same carbon content

______b. A silvery-white, hard ductile metallic element used to make special steels with increased strength, improved ductility, and added toughness at low temperatures

______c. A silvery-white, hard metallic element used to make special steels that require increased hardness or strength in hot temperature surface applications

______d. A silvery-white metallic element used to make special steels with added tensile strength

______e. A nonmetallic element added to iron to make steels that are harder and stronger

______f. A steel-gray, brittle metallic element used to make special hard steels used in tool manufacturing

______g. A hard, brittle nonmetallic element used to make special steels that are hard and brittle

1. Nickel
2. Carbon
3. Cobalt
4. Manganese
5. Chromium
6. Tungsten
7. Molybdenum

TEST

______h. A grayish-white, red-tinged nonmetallic element that is used to make special steels that are hard but less brittle

______i. A hard, steel-gray element used to make steels subject to corrosive or high-temperature service

8. Silicon
9. Vanadium

16. Match metals with ways to identify them by appearance.

______a. Dark gray when new, but will rust with age, and rust rapidly when stored outside

______b. Dull cast surface when new, but will rust with age, and rust rapidly when stored outside

______c. Bright, silvery, and smooth when new, but some grades will rust and other grades will tarnish

______d. Dull gray with evidence of sand mold, and will rust rapidly in almost any environment

______e. Light gray and smooth, and will rust rapidly in almost any environment

______f. Silvery-white with a smooth surface, is highly rust and corrosion resistant except when alloyed with certain other elements, and weighs much less than iron or steel

______g. Reddish-brown with a dull finish, and highly subject to tarnishing

______h. White with a hard finish, and has a good resistance to rust and corrosion

1. Cast iron
2. Wrought iron
3. Copper
4. Low, medium, and high carbon steel
5. Nickel
6. Manganese steel
7. Aluminum
8. Stainless steel

17. Solve the following problems concerning systems for identifying steel.

a. In the designation AISI E 2512, the first "2" in the four-number digit indicates that the steel has nickel alloy, but what does the "5" following the "2" indicate?

Answer: ____

____

TEST

b. From the following two identification numbers, AISI C 1020 and T00001, which one is from the Unified Numbering System?

Answer: ______________________________

18. Complete the following chart of carbon steel classifications, characteristics, and uses.

Classification	**Characteristics**	**Typical Uses**
a. ________	0.07% to 0.15% carbon	Nails, iron bars and rods, auto bodies, and pipes
b. ________	0.15% to 0.25% carbon	Gears, shafts, bolts, metal frames, angles, and channels
c. ________	0.25% to 0.60% carbon	Axles, shafts, machine bolts, boilers, hammers, and sledges
d. ________	0.60% to 1.50% carbon	Screwdrivers, crow bars, axes, springs, razors, and fine cutters

TEST

19. Complete the following chart of alloy steel classifications, characteristics, and uses.

Classification	Characteristics	Typical Uses
a. ______________	Strong and hard, resists corrosion, withstands shocks, vibration, and wear	Wire cables, railroad and car axles, and steel rails
Chromium steel	Fine grain, tough and strong, resists corrosion, shocks, and scratches	Auto bearings and safes
b. ______________	Does not corrode, has a bright, silvery finish that looks good	Sinks, tables, and food service items subject to high standards of cleanliness
Chrome-nickel steel	Hard and strong	Auto gears, springs, axles, and armor plate
Manganese steel	Tough and strong, can resist strain, shock, and hammering	Jaws of rock crushers, chains, gears, and safes
Molybdenum steel	Tough and strong, resists heat and impact wear	Auto parts, high-grade machinery, and roller bearings
Tungsten steel	Hard, fine grained, and resists heat	High-speed metal cutting tools
c. ______________	Holds magnetism well	Electrical measuring instruments
d. ______________	Hardest man-made metal	Cutting tools and dies
e. ______________	Tough, but lightweight, fine grained, and resists shock	Auto axles, gears, and springs
Stellite	Extremely hard	Heavy cutting tools
High-speed steel	Self-hardening steel	Cutting tools, taps, and drills

TEST

20. Complete the following chart of iron classifications, characteristics, and uses.

Classification	Characteristics	Typical Uses
a. ____________	Resists corrosion, withstands shock, is malleable and easy to bend hot or cold	Rivets, bolts, nails, horseshoes, and ornamental iron
b. ____________	Relatively inexpensive, high compressive strength, but low tensile strength and brittle	Large pipes, stoves, water hydrants, and machinery frames
c. ____________	Very hard and brittle	Machine parts subjected to extreme wear or abrasion
d. ____________	Tougher and more impact resistant than other cast irons	Farm tools, implement parts, and railroad equipment

21. Select true statements concerning aluminum, its characteristics and uses by placing an "X" in the appropriate blanks.

_____a. Aluminum is the most used but least abundant of the nonferrous metals

_____b. Aluminum is a silvery-white metal with a brilliant surface beauty that resists corrosion, and is maintenance free

_____c. Pure aluminum is very soft and difficult to use so it is usually combined with an alloy to change its characteristics

_____d. Aluminum is a poor conductor of electricity, a poor reflector of heat even when it is polished, and a poor thermal conductor

_____e. Aluminum is both malleable and ductile and can easily be formed into shapes or into wire

_____f. Aluminum is available in sheets, plates, bars, wires, pipes, and tubes

_____g. Aluminum is also available in a great number of extruded forms

22. Solve the following problems concerning th AA system of identifying aluminum and aluminum alloys.

a. Aluminum bearing any number code in the 1000 series would indicate what?

Answer: ____

TEST

b. Aluminum bearing any number code in the 2000 series and beyond would indicate what?

Answer: ______________________________

23. Solve the following problems concerning the AA temper designation system for aluminum.

a. In the number 5083-H34, the 5083 is the alloy designation, but what does the H34 designate?

Answer: ______________________________

b. Since strength tempers are expressed on a base of 8, what would the strength temper 8 designate?

Answer: ______________________________

24. Match other aluminum abbreviations with their meanings.

______a. Aircraft quality — 1. HTQ
______b. Commercial quality — 2. AQ
______c. High tensile quality — 3. CQ

25. Arrange in order the steps in identifying aluminum by placing the correct sequence number in the appropriate blank.

______a. Determine the quality designation
______b. Determine number code series
______c. Determine the H or T designation
______d. Determine the principal alloying element
______e. Determine the hardness percentage

26. Select true statements concerning chemical tests for identifying aluminum alloys by placing an "X" in the appropriate blank.

(NOTE: For a statement to be true, all parts of the statement must be true.)

______a. The copper, nickel, zinc test

1) Used to identify the more readily weldable alloys from the 2000 and 7000 series aluminum alloys

TEST

2) Consists of placing a drop of 20% sodium hydroxide on the surface of the alloy being tested only after oxides have been removed from the base metal surface

3) If a black spot forms in 1 to 5 minutes it indicates moderate to large amounts of copper, nickle, and zinc

_____b. The manganese test

1) Used to identify the more readily weldable alloys 3003 and 3004 which contain 1 to 1.5% manganese

2) Consists of preheating the aluminum to about 200°F, placing a few drops of silver nitrate on the surface, then adding a few small crystals of ammonium presulfate

3) If the spot turns blue and stays blue as long as the aluminum is warm, it indicates a definite presence of manganese

27. Match other nonferrous metals with their typical uses.

_____a. Used in electric and telephone wires, and alloyed with zinc or tin to form brass or bronze, and in industrial applications because it is the second best conductor of electricity

_____b. Used to galvanize iron and steel for protection from rust

_____c. Used in everything from lawnmower engine blocks to space vehicles because it is lightweight

_____d. Used primarily as an alloy to toughen steel

_____e. Used in supersonic aircraft because of its high heat resistance and capacity to withstand vibration, and in petrochemical applications because of its high corrosion resistance

_____f. Used in the space program because of its light weight and high heat resistance

_____g. Used for jewelry, coins, and coating electrical devices, and usually alloyed with copper or nickel because it is too soft for general use

1. Lead
2. Zinc
3. Silver
4. Copper
5. Tin
6. Magnesium
7. Gold

TEST

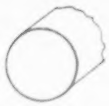
_____h. Used in auto batteries and alloyed with tin to make solder

_____i. Used in coins, jewelry, tableware, and in industrial applications because it is the best conductor of electricity

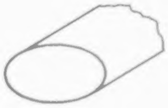
_____j. Used for making tin cans, and used as an alloy to make bronze, babbitt, pewter, and solder

8. Nickel
9. Beryllium
10. Titanium

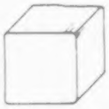
28. Identify the following standard metal shapes available for welding by writing the name of the shape below each illustration.



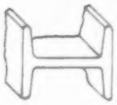
a. ____________________



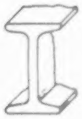
b. ____________________



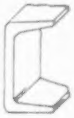
c. ____________________



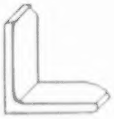
d. ____________________



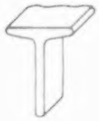
e. ____________________



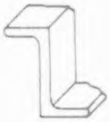
f. ____________________



g. ____________________

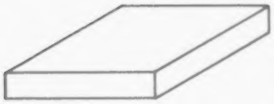


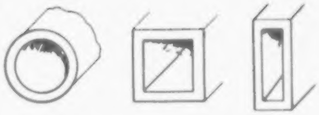
h. ____________________

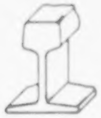


i. ____________________

TEST







j. ______________ k. ______________ l. ______________

29. Select true statements concerning equipment requirements for spark testing by placing an "X" in the appropriate blanks.

______a. Stationary or portable power grinder

______b. A medium-grit grinding wheel such as 40 to 60 grit

______c. A grinding wheel turning rate with a very low rpm

______d. A grinding wheel that has been dressed to remove traces of glazing or metal particles left from previous grinding

30. Select true references to terminology used in spark testing by placing an "X" in the appropriate blanks.

(NOTE: For a reference to be true, all parts of the reference must be true.)

______a. Arrow

______b. Shaft

______c. Feather

______d. Sprigs

______e. Stream

______f. Color

1) Red color at grinding wheel usually indicates cast iron
2) Straw color at end of stream usually indicates cast iron
3) Straw or light orange color at grinding wheel usually indicates alloy steel
4) Green color at grinding wheel usually indicates low or high carbon steel
5) Brown color usually indicates the presence of chromium

TEST

_____g. Volume of sparks

1) None for nonferrous metals

2) Small for gray cast iron and very small for white cast iron

3) Moderately large for low carbon steel

4) Large for high carbon steel

5) Moderate to large for stainless steel depending on type and amount of alloy

_____h. Length is distance the spark pattern or stream travels from the grinding wheel

31. Select true statements concerning residual stresses and what they mean by placing an "X" in the appropriate blanks.

(NOTE: For a statement to be true, all parts of the statement must be true.)

_____a. Residual means "what is left at the end of a process," so, in welding, residual stresses refer to the forces and counterforces that leave stresses in a structure or part after a welding operation is completed

_____b. Residual stresses can produce shrinkage and other forms of distortion that make parts difficult or impossible to fitup

_____c. Residual stresses can produce in base metals structural and metallurgical changes so severe that a welded assembly could fail in service and damage property or hurt people

_____d. The presence of excessive residual stresses in a part or an assembly indicates that something in the welding procedure needs to be changed:

1) Joint design and fitup may need modification

2) The welding process itself may need modification

3) Filler metals or base metals may need modification

4) Thermal or mechanical controls may be needed to correct the problem

a) Thermal controls include preheating, interpass heating, and post heating

b) Mechanical controls include C-clamps, strongbacks, wedges, and many types of restraining jigs and fixtures

TEST

32. Complete statements concerning causes of residual stresses and distortion by inserting the word(s) that best completes each statement.

    a. Filler metals and base metals in a welding procedure have to be heated to a melting point or near melting point, and as they are heated, they ________________, but not uniformly

    b. During and after the welding operation, filler metals and base metals ________________ as they cool, but not uniformly

    c. This lack of uniformity in expansion and contraction means that residual stresses will vary with joint design, welding procedure, and metal type and thickness, and the ________________ the metals, the more problems with residual stresses

    d. Once heat is applied, it has to go somewhere, and the ways heat escapes from a weld can be a clue to ________________ residual stresses

    e. In a normal butt weld, heat escapes ________________ in both directions from the joint

    f. In a normal fillet weld, heat escapes ________________ from the sides and ________________ from the top

    g. In a butt weld, the first passes can produce distortion *down* the length of the weld bead, and this is called ________________ stress

    h. As the first passes of a butt weld solidify, the movement *across* the weld bead is also restricted, and this is called ________________ stress

    i. The combination of ________________ and ________________ stresses in a butt weld result in distortion that usually causes the plates to rise from a flat or even position to a slight angle

    j. In a fillet weld, the combination of longitudinal and transverse stresses not only causes a change from flat to a slight angle, but can produce a ________________ or ________________ along the length of the parts

33. Match heat applications with their uses in weld quality control.

    ______a. Heating a part before the welding process starts to help control cracking, stresses from shrinkage, and to promote a slower cooling rate to prevent excessive hardening

    ______b. Heating between welding passes to maintain the preheat temperature

    ______c. Heating a part after the welding process and allowing it to cool slowly to promote stress relief in the weldment and the base metal

    1. Interpass heat
    2. Preheat
    3. Postheat

TEST

34. List three situations where preheat is usually required.

a. ____

____

b. ____

____

c. ____

____

35. Complete a list of methods of preheating and postheating by inserting the word(s) that best completes each statement.

a. Furnaces

b. Electrical ____________ heaters clamped parallel to joints about 6" from the seam

c. Acetylene, propane, or oil torches used ____________ or in ____________ of two or more

d. Torch heating using natural gas with compressed air using a single-orifice heating tip the ____________ ____________ that would be used to oxyacetylene weld the joint

e. Torch heating using ____________ heads or rosebuds

36. Match torch preheating techniques with their applications.

_____a. Heat applied at one specific point so that cooling will cause a slight inward movement around the point and help control nondirectional distortion

_____b. Heat applied along a seam or perpendicular to a seam to control directional distortion

_____c. Since the side where heat is applied will always shorten more than the other side, spot and slot heating should be applied on the convex side when attempting to flatten plates

1. Spot heating
2. Slot heating
3. Convex heating

TEST

37. Match types of steels with their recommended preheat temperatures.

______a. Preheating is not normally required, but if temperature is below 50°F, preheat to about 100°F or higher if the plate thickness is over 1"

______b. Preheat from 200°F to 400°F, retain the same interpass temperature, and postheat is recommended, especially on thicker sections

______c. Preheat and interpass temperatures should be a minimum of 400°F, and postheat is recommended, especially on thicker sections

1. Medium carbon steels
2. High carbon steels
3. Mild steels

38. Match temperature-sensing devices with their uses.

______a. Portable thermometers specifically designed to measure surface heat

______b. Temperature-sensing devices that may be attached to the work, but more often used in heating ovens and postweld heat treatment

______c. Temperature-sensing devices that melt suddenly when the work reaches a specific temperature

1. Crayons and pellets
2. Thermocouples
3. Pyrometers

39. Complete statements concerning ways to control distortion in welding by inserting the word(s) that best completes each statement.

a. Do not overweld

1) The more metal placed in a joint, the ________________ the shrinkage forces

2) Excess weld metal does not ________________ weld strength, but it does ________________ shrinkage forces

b. Modify edge preparation and fitup when butt welding thicker metals

1) Plates for butt welds on thinner metals provide good fusion and require minimum weld metal with a ________________ bevel on each side with plates spaced 1/32" to 1/16" apart

2) For thicker plates, ________________ the bevel angle and increase the root opening or use a J or U joint design

3) A double V-joint requires about ________________ the weld metal of a single V-joint for the same plate thickness

TEST

c. Use intermittent welding

1) Intermittent welds provide needed ________________

2) Intermittent welds ________________ the amount of weld metal required

d. Use as few passes as required

1) Each pass ________________ the possibility for increased shrinkage

2) Fewer passes with ________________ electrodes are better than more passes with ________________ electrodes

e. Place welds near a neutral axis

1) Weld design and weld ________________ can both help control shrinkage

2) Welding at or along a ________________ axis gives less leverage to forces that cause distortion

f. Use backstep welding

1) Direction of welding is usually ________________ to ________________, but beads deposited from ________________ to ________________ so that heat will spread uniformly to outer edges should bring plates back in alignment

2) Not an economical procedure for ________________ welding

g. Preset parts to take advantage of shrinkage

1) Anticipate the places of shrinkage and amount of shrinkage and position parts so that they will be ________________ ________ ________________ during welding

2) The process requires good ________________, but a few trial welds should indicate how to preset the parts

h. Prebend and clamp parts or clamp parts back to back

1) Prebending actually makes the joint ________________ so that shrinkage will cause the joint to be flat as the plate cools and the clamps are released

2) Clamping similar parts ________________ ________ ________________ helps distortion forces work against each other to control shrinkage

TEST

i. Weld in a logical sequence

1) Weld at different points in the assembly so that as the part shrinks in one place it ________________ the shrinkage forces of welds already made

2) Alternate sides on fillet welds and use ________________ welding so that shrinkage in the first weld is counterbalanced by shrinkage in the second weld, shrinkage in the second weld is counterbalanced by shrinkage in the third weld, etc.

40. Complete statements concerning ways to control distortion with restraining devices by inserting the word(s) that best completes each statement.

a. When butt welding plates, ________________ ________________ clips along the edge of one plate, then drive wedges under the open side of the clip to force the edges into alignment

b. Tack weld a yoke to a backup strip, slip the yoke between the edges, then place a ________________ yoke on top of the plates and drive a wedge through the first yoke to align the plates

c. For butt welds on ________________ plates, tack weld a yoke on top of one plate, a bar to the top of the second plate, then drive a wedge between the yoke and the bar

d. When there is a possibility that the use of several strongbacks would restrain the weld so much that it would produce cracking as the weld cools, position the strongbacks at a ________________ angle across the joint to allow transverse movement

41. Select true statements concerning guidelines for correcting distortion in welded components by placing an "X" in the appropriate blanks.

______a. Determine width of distortion at maximum point

______b. Determine length of distortion

______c. Determine out of tolerance distortion in inches or fractions of an inch

______d. There is no need to sketch dimensions, but do keep a good mental picture of the problem to use as a work reference

TEST

42. Arrange in order the procedure for straightening a distorted steel member by placing the correct sequence number in the appropriate blank.

_____a. As point C turns a light red, move the flame slowly toward point B as you widen the heating pattern by moving the torch in a circular motion toward the extremes of the out-of-tolerance dimensions of points D and E

_____b. As the flame moves from point C, the metal at that point cools and "upsets" or expands into itself

_____c. Determine dimensions of needed correction

_____d. Mark work area and dimensions with a soapstone so that point C is situated from point A a distance equal to one third the width of the member

_____e. The widening heat pattern plus the cooling and contraction of the metal behind it will cause the edge at B to stretch at first, but then it will contract on cooling and serve to straighten the member

_____f. Start heat at point C with flame pointing toward point B

_____g. Heat point C to a light red, but not enough to melt the surface

43. Identify selected metals by appearance, color, and corrosion characteristics.

44. Identify metal shapes used for welding.

45. Prepare a working reference for straightening a distorted steel member.

46. Demonstrate the ability to:

    a. Conduct magnet tests to identify common metals used for welding.

    b. Conduct spark tests to identify common metals used for welding.

    c. Conduct chisel tests to identify common metals used for welding.

(NOTE: If these activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

BASIC METALS AND METALLURGY
UNIT IV

ANSWERS TO TEST

1.
   - a. 3
   - b. 7
   - c. 9
   - d. 11
   - e. 4
   - f. 1
   - g. 2
   - h. 6
   - i. 8
   - j. 12
   - k. 10
   - l. 5

2.
   - a. Filler
   - b. Interpass
   - c. Processes
   - d. Compatibility

3.
   - a. Iron
   - b. No iron, iron

4.
   - a. Two
   - b. One

5.
   - a. 4
   - b. 5
   - c. 1
   - d. 6
   - e. 7
   - f. 3
   - g. 2

6.
   - A. Mechanical or physical
   - b. Physical or mechanical

7.
   - a. 2
   - b. 4
   - c. 6
   - d. 8
   - e. 10
   - f. 9
   - g. 7
   - h. 5
   - i. 3
   - j. 1

8.
   - a. 3
   - b. 1
   - c. 2
   - d. 4

9.
   - a. 1
   - b. 2
   - c. 3
   - d. 4
   - e. 5

10.
   - a. −300°F
   - b. Lower, lower

ANSWERS TO TEST

11. a. 1000°F
b. 700°F
c. More brittle
d. Extremely hard skin

12. a. 2050°F
b. Slowly
c. Softness
d. A change in atomic arrangements
e. Slowly
f. Hard, high-carbon steel
g. Can be

13. a. 2900°F
b. 2400°F
c. Burning
d. Remelted
e. Liquid

14. a, b, c

15\.

a.	5	f.	6
b.	1	g.	8
c.	7	h.	4
d.	9	i.	3
e.	2		

16\.

a.	4	e.	2
b.	6	f.	7
c.	8	g.	3
d.	1	h.	5

17. a. The percentage of nickel alloy
b. T00001

18. a. Low carbon
b. Mild steel
c. Medium carbon
d. High carbon

19. a. Nickel steel
b. High chromium steel
c. Tungsten steel, magnet steel
d. Tungsten steel, tungsten carbide
e. Vanadium steel

20. a. Wrought iron
b. Gray cast iron
c. White cast iron
d. Malleable cast iron

ANSWERS TO TEST

21. b, c, e, f, g

22. a. Unalloyed aluminum of 99% aluminum or more
    b. Any aluminum alloy

23. a. The temper designation
    b. 8/8 or full hard

24. a. 2
    b. 3
    c. 1

25. a. 5
    b. 1
    c. 3
    d. 2
    e. 4

26. a

27. a. 4
    b. 2
    c. 6
    d. 8
    e. 10
    f. 9
    g. 7
    h. 1
    i. 3
    j. 5

28. a. Round bar
    b. Oval bar
    c. Square bar
    d. H beam
    e. I beam
    f. Channel
    g. Angle
    h. Tee
    i. Zee
    j. Flat plate
    k. Tubing and pipe
    l. Rail

29. a, b, d

30. a, b, d, e, g, h

31. a, b, c, d

32. a. Expand
    b. Contract
    c. Thicker
    d. Controlling

ANSWERS TO TEST

e. Outward
f. Outward, upward
g. Longitudinal
h. Transverse
i. Longitudinal, transverse
j. Roll, twist

33. a. 2
b. 1
c. 3

34. Any three of the following:
a. When large or bulky parts are being welded or when parts being welded have a complicated shape
b. When the atmospheric temperature is cold or the temperature of the parts is cold
c. When the carbon or alloy content of steel is high
d. When the welding speed is fast
e. When small-diameter welding rods are used

35. b. Strip
c. Singly, banks
d. Same size
e. Multiflame

36. a. 1
b. 2
c. 3

37. a. 3
b. 1
c. 2

38. a. 3
b. 2
c. 1

39. a. 1) Greater
2) Increase, increase
b. 1) 30°
2) Decrease
3) Half
c. 1) Strength
2) Reduce
d. 1) Increases
2) Larger, smaller
e. 1) Sequence
2) Neutral
f. 1) Left to right, right to left
2) Automatic

ANSWERS TO TEST

g. 1) Pulled into alignment
   2) Estimating
h. 1) Longer
   2) Back to back
i. 1) Counteracts
   2) Intermittent

40. a. Tack weld
    b. Guide
    c. Thicker
    d. 45°

41. a, b, c

42.

42.	a.	5	e.	7
	b.	6	f.	3
	c.	1	g.	4
	d.	2		

43. Evaluated to the satisfaction of the instructor

44. Evaluated to the satisfaction of the instructor

45. Evaluated to the satisfaction of the instructor

46. Performance skills evaluated to the satisfaction of the instructor

BASIC MATH AND MEASURING

UNIT V

UNIT OBJECTIVE

After completion of this unit, the student should be able to add, subtract, multiply, and divide whole numbers, fractions, and decimals, and convert fractions to decimals and percents. The student should also be able to use specified graduations to measure with a rule, use three procedures to adjust a bevel square to a 45° angle, and use a combination square to make 45° and 90° angles and draw parallel lines on metal stock. This knowledge will be evidenced by correctly completing the procedures outlined in the assignment and job sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to basic math and measuring with their correct definitions.
2. Match basic mathematical terms with their definitions and give an example for each.
3. Select true statements concerning advantages of a decimal equivalent and conversion charts.
4. Complete statements concerning uses for fractions.
5. Select true statements concerning uses for decimals.
6. Complete definitions of methods for expressing fractions and decimal equivalents.
7. Select true statements concerning percent and its uses.
8. Complete lists of units of measure found on rules.
9. Arrange in order the steps for reading a rule.
10. Arrange in order the steps for finding mid-point of a given distance.
11. Complete formulas for perimeters.
12. Calculate perimeters for rectangles, squares, and triangles.
13. Identify basic geometric figures.
14. Calculate areas of basic geometric figures.

OBJECTIVE SHEET

15. Calculate measurements for circles.

16. Size commonly used steel stock from scale drawings.

17. Demonstrate the ability to:

    a. Add, subtract, multiply, and divide fractions.

    b. Add, subtract, multiply, and divide decimal equivalents.

    c. Convert fractions to decimal form.

    d. Write fractions as decimals and percents.

    e. Write percents as fractions and decimals.

    f. Write decimals as fractions and percents.

    g. Make conversions with the decimal equivalent and inches to decimal conversion charts.

    h. Use the English-Metric Conversion Chart.

    i. Measure distance with 1", 1/2", and 1/4" graduations.

    j. Measure distances with 1/4" and 1/8" graduations.

    k. Measure distances with 1/8" graduations.

    l. Measure distances with 1/16" graduations.

    m. Measure given line segments with 1/16" graduations.

    n. Measure dimensions of given objects with a rule.

    o. Measure given lines and objects with a rule.

    p. Use a rule to draw lines and objects to given specifications.

    q. Find the mid-point of given lines and figures.

    r. Calculate the perimeters of given rectangles.

    s. Calculate the perimeters of given squares.

    t. Calculate the perimeters of given triangles.

    u. Calculate the areas of given parallelograms.

OBJECTIVE SHEET

v. Calculate the areas of given rectangles.

w. Calculate the areas of given squares.

x. Calculate the areas of given triangles.

y. Calculate the areas of given rhombuses.

z. Calculate the areas of given trapezoids.

aa. Calculate the circumferences of given circles.

bb. Calculate the areas of given circles.

cc. Adjust a bevel square to a 45° angle using a framing square, a combination square, and a protractor.

dd. Use a combination square to form 90° and 45° angles and to draw parallel lines on selected metal stock.

BASIC MATH AND MEASURING
UNIT V

SUGGESTED ACTIVITIES

I. Provide student with objective sheet.

II. Provide student with information, assignment, and job sheets.

III. Make transparencies.

IV. Discuss unit and specific objectives.

V. Discuss and demonstrate procedures outlined in the job sheets.

VI. Demonstrate the procedures for measuring with different measuring instruments, emphasize accuracy and the correct marking of reference points.

VII. Select pieces of longer and larger metal stock and have students measure them with a rule to give students practice with greater distances than are used in the assignment sheets.

VIII. Demonstrate how to properly use and clean a steel tape.

IX. Give test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

  A. Objective sheet

  B. Information sheet

  C. Transparency masters

    1. TM 1 — Decimal Equivalent Chart

    2. TM 2 — Inches to Decimal Conversion Chart

    3. TM 3 — Fractional and Decimal Equivalents

    4. TM 4 — Units of Measurement

    5. TM 5 — Eighths Rule

    6. TM 6 — Sixteenths Rule

  D. Assignment sheets

    1. Assignment Sheet #1 — Add, Subtract, Multiply, and Divide Fractions

INSTRUCTIONAL MATERIALS

2. Assignment Sheet #2 — Add, Subtract, Multiply, and Divide Decimal Equivalents
3. Assignment Sheet #3 — Convert Fractions to Decimal Form
4. Assignment Sheet #4 — Write Fractions as Decimals and Percents
5. Assignment Sheet #5 — Write Percents as Fractions and Decimals
6. Assignment Sheet #6 — Write Decimals as Fraction and Percents
7. Assignment Sheet #7 — Make Conversions With the Decimal Equivalent and Inches to Decimal Conversion Charts
8. Assignment Sheet #8 — Use the English-Metric Conversion Chart
9. Assignment Sheet #9 — Measure Distances With 1", 1/2", and 1/4" Graduations
10. Assignment Sheet #10 — Measure Distances With 1/4" and 1/8" Graduations
11. Assignment Sheet #11 — Measure Distances With 1/8" Graduations
12. Assignment Sheet #12 — Measure Distances With 1/16" Graduations
13. Assignment Sheet #13 — Measure Given Line Segments With 1/16" Graduations
14. Assignment Sheet #14 — Measure Dimensions of Given Objects With a Rule
15. Assignment Sheet #15 — Measure Given Lines and Objects With a Rule
16. Assignment Sheet #16 — Use a Rule to Draw Lines and Objects to Given Specifications
17. Assignment Sheet #17 — Find the Mid-Point of Given Lines and Figures
18. Assignment Sheet #18 — Calculate the Perimeters of Given Rectangles
19. Assignment Sheet #19 — Calculate the Perimeters of Given Squares
20. Assignment Sheet #20 — Calculate the Perimeters of Given Triangles
21. Assignment Sheet #21 — Calculate the Areas of Given Parallelograms
22. Assignment Sheet #22 — Calculate the Areas of Given Rectangles

INSTRUCTIONAL MATERIALS

23. Assignment Sheet #23 — Calculate the Areas of Given Squares
24. Assignment Sheet #24 — Calculate the Areas of Given Triangles
25. Assignment Sheet #25 — Calculate the Areas of Given Rhombuses
26. Assignment Sheet #26 — Calculate the Areas of Given Trapezoids
27. Assignment Sheet #27 — Calculate the Circumferences of Given Circles
28. Assignment Sheet #28 — Calculate the Areas of Given Circles

E. Answers to assignment sheets

F. Job sheets

1. Job Sheet #1 — Adjust a Bevel Square to a 45° Angle Using a Framing Square, a Combination Square, and a Protractor
2. Job Sheet #2 — Use a Combination Square to Form 90° and 45° Angles and to Draw Parallel Lines on Selected Metal Stock

G. Test

H. Answers to test

II. References:

A. Bernstein, Allen L. and David W. Wells. *Trouble-Shooting Mathematics Skills.* New York: Holt, Rinehart and Winston Inc., 1969.

B. Lennes, N. J. and L. R. Travers. *Lennes Essentials of Arithmetric.* Dallas, TX: Laidlaw Brother, 1964.

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BASIC MATH AND MEASURING
UNIT V

INFORMATION SHEET

I. Terms and definitions

A. A or a — Area, the measure of the surface inside a figure

B. B or b — Base

C. H or h — Height

D. L or l — Length

E. P or p — Perimeter, the distance around the edge of a flat surface

F. S or s — Side or length of a side

G. T or t — Thickness

H. W or w — Width

I. C or c — Circumference, the distance around a circle

J. D or d — Diameter, the distance across the center of a circle

K. R or r — Radius, half the distance of the diameter of a circle

L. Graduations — Subdivisions on a rule that are equal in length

M. Square measure — A system of measuring area

N. Cubic measure — A system of measuring volume

O. Sublinear numbers — Numbers which appear below a line to clarify a reference such as base one, b_1, or base two, b_2

P. Superlinear numbers — Numbers which appear above a line to usually indicate the square of a number or letter designation or an increase in power such as R^2 or r^2 indicates that a radius should be multiplied times itself

Q. Pi (π) — A letter from the Greek alphabet used to identify 3.1416 or 3.14, and used to establish the ratio of the circumference of a circle to its diameter

(NOTE: In critical measurement, π is sometimes carried several digits further, 3.141592654+.)

INFORMATION SHEET

II. Basic mathematical terms and their definitions

A. Whole number — Any number or numbers used to indicate an entire unit, quantity, or amount

Example: 1, 3, 10, 25

B. Fraction — Two numbers consisting of a numerator and denominator separated by a fraction line to indicate a part of one unit

Example: 1/8, 1/4, 1/2, 1/16, 1/32, 1/64

C. Mixed number — Any whole number plus a fractional part of one additional unit

Example: 1 1/8, 3 1/4, 5 1/2, 6 3/4

D. Numerator — The top number of a fraction

Example: The numerator of 1/3 is 1

E. Denominator — The base or lower number of a fraction

Example: The denominator of 3/4 is 4

F. Proper fraction — A fraction whose numerator is less than the denominator, indicating a value of less than one unit

Example: 5/16, 3/8, 7/8, 9/16

G. Improper fraction — A fraction whose numerator is equal to or greater than the denominator, indicating a value greater than one unit

Example: 9/8, 18/16, 3/2, 7/4

H. Unit fraction — A proper fraction with a numerator of 1

Example: 1/3, 1/4, 1/2

I. Complex fraction — A fraction with either or both terms expressed as a fraction or mixed number

Example: $\frac{7}{1/16}$ $\frac{5\,1/2}{2\,3/4}$

J. Lowest terms — The lowest base number (numerator and denominator) by which a fraction may be reduced for simplification in unit measurement

Example: 12/16 = 6/8 = 3/4 which is the lowest term

INFORMATION SHEET

K. Common denominator — Two fractions with the same denominator in each fraction (proper or improper) which allows for simplification in adding and dividing fractions

Example: $1/8 + 1/16 + 1/32 + 1/64 = 8/64 + 4/64 + 2/64 + 1/64 = 15/64$

L. Factors — The parts of a number that can be multiplied to equal that number

Example: 2 and 5 are factors of 10 because 2 × 5 = 10; 6 and 2 and 3 and 4 are factors of 12 because 6 × 2 = 12 and 3 × 4 = 12

M. Sum — The result of addition

Example: 4 is the sum of 2 + 2

N. Quotient — The result of division

Example: 2 is the quotient of 4 ÷ 2

III. Advantages of decimal equivalent and conversion charts (Transparencies 1 and 2)

A. Convenience of converting units

1. Fractions to decimals
2. Decimals to fractions
3. Feet and inches to decimals and vice versa

B. Saves time

C. Establishes standard for unit conversion

D. Lists sizes from smallest to largest

E. Easy to read

IV. Uses for fractions

A. Combines parts of a unit or units into a total amount

B. Allows a system for adding, subtracting, multiplying, or dividing parts of a unit

V. Uses for decimals

A. Allows for a greater method of accuracy than fractional form

B. Provides a conversion system for measuring materials

INFORMATION SHEET

VI. Methods of expressing fractions and decimal equivalents (Transparency 3)

  A. Word — May be in writing or may be spoken

  Example: Six and seven eighths

  B. Number — Always in writing; a system of numerators, denominators, whole numbers, mixed numbers, and other forms to signify a value

  Example: $^{21}/_{64} = 0.3281$

VII. Percent and its uses

  A. Percent is based upon hundredths and is used to express the ratio of an amount related to one hundred

  Example: 20 items out of 100 would be $^{20}/_{100}$ or 20%

  B. 100% means the total amount of items or amounts in question

VIII. Units of measure found on rules (Transparency 4)

  A. Fractional

    1. Eighths ($^{1}/_{8}$") (Transparency 5)

    2. Sixteenths ($^{1}/_{16}$") (Transparency 6)

    3. Thirty-seconds ($^{1}/_{32}$")

    4. Sixty-fourths ($^{1}/_{64}$")

  B. Decimal

    1. Tenths (0.1)

    2. Hundredths (0.01)

    3. Thousands (0.001)

  C. Metric

    1. Meter (1.0m)

    2. Decimeter (0.1m)

    3. Centimeter (0.01m)

    4. Millimeter (0.001m)

INFORMATION SHEET

IX. Steps for reading a rule

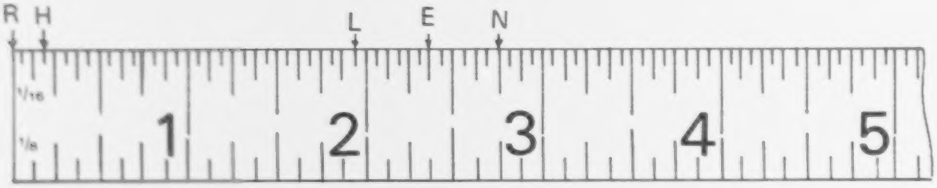
A. Select proper scale

B. Count whole units

C. Total the number of graduations

D. Reduce graduations to lowest terms

Example: When measuring the distance from R to E in the following illustration, the third mark past 2″ indicates it is the $^{1}/_{8}$″ scale, there are two whole units, two full inches preceding the fractional measure, and there are $^{6}/_{16}$ graduations following the whole units, so $^{6}/_{16}$ should be reduced to the lowest terms, and the measurement from R to E is 2 $^{3}/_{8}$″



X. Steps for finding mid-point of a given distance

A. Measure the total distance

B. Divide the distance by two or multiply it by one-half

C. Reduce graduation to lowest terms

Example: In the previous illustration, the distance from R to N is 2 $^{3}/_{4}$″, half this length would be 2 $^{3}/_{4} \times {}^{1}/_{2}$ or $^{11}/_{4} \times {}^{1}/_{2}$ which would be $^{11}/_{8}$, and this reduced to lowest terms would be 1 $^{3}/_{8}$″ which would be the mid-point from either end of the measured distance

XI. Formulas for perimeters

A. Rectangle — $P = 2L + 2W$

B. Square — $P = 4s$

C. Triangle — $P = s_1 + s_2 + s_3$

INFORMATION SHEET

XII. Calculating perimeters for rectangles, squares, and triangles

A. Rectangle — length = 4′, width = 3′

(NOTE: The symbol 4′ and 3′ means 4 feet and 3 feet.)

$P = 2L + 2W$
$P = (2 \times 4) + (2 \times 3)$
$P = 8 + 6$
$P = 14'$

(NOTE: Label the answer with the correct unit of measure.)

B. Square — length of a side = 6″

(NOTE: The Symbol 6″ means 6 inches.)

$P = 4s$
$P = 4 \times 6$
$P = 24''$

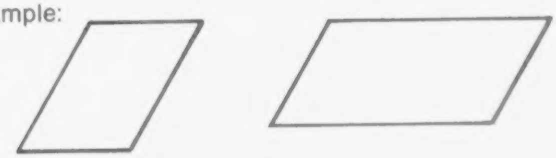
C. Triangle — length of one side = 2′, length of another side = 3′, length of the third side = 8′

$P = s_1 + s_2 + s_3$
$P = 2 + 3 + 8$
$P = 13'$

XIII. Basic geometric figures

A. Parallelogram

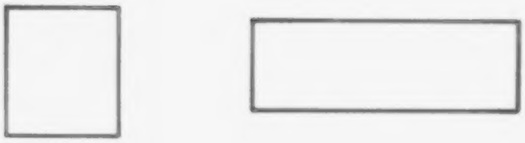
Example:



INFORMATION SHEET

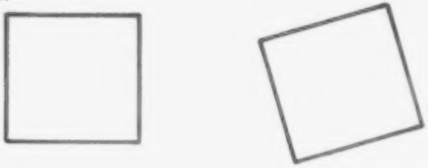
B. Rectangle

Example:



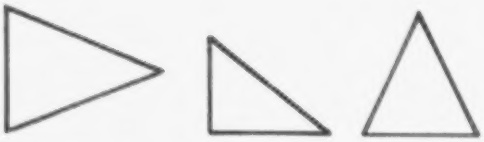
C. Square

Example:



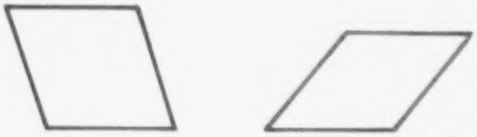
D. Triangle

Example:



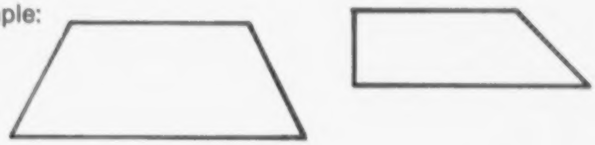
E. Rhombus (all sides of equal length)

Example:



F. Trapezoid

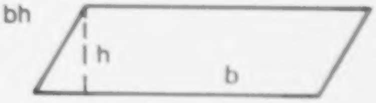
Example:



INFORMATION SHEET

XIV. Formulas for calculating areas of basic geometric figures

A. Parallelogram — $A = bh$



Example: Parallelogram — b = 12", h = 7"

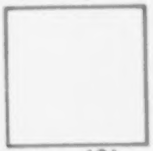
$A = bh$
$A = 12 \times 7$
A = 84 square inches

B. Rectangle — $A = lw$

Example: Rectangle — l = 9 yards, w = 2 yards

$A = l \times w$
$A = 9 \times 2$
A = 18 square yards

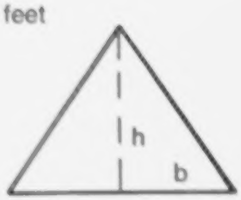
C. Square — $A = s^2$



Example: Square — s = 10'

$A = s^2$
$A = 10 \times 10$
A = 100 square feet

D. Triangle — $A = \frac{1}{2} bh$

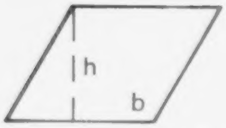


Example: Triangle — b = 12", h = 7"

$A = \frac{1}{2} bh$
$A = \frac{1}{2} \times 12 \times 7$
$A = 6 \times 7$
A = 42 square inches

INFORMATION SHEET

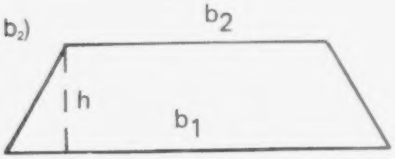
E. Rhombus — $A = bh$



Example: Rhombus — $b = 9$ miles, $h = 2\frac{1}{3}$ miles

$A = bh$
$A = 9 \times 2\frac{1}{3}$
$A = \frac{9}{1} \times \frac{7}{3}$
$A = \frac{63}{3}$
$A = 21$ square miles

F. Trapezoid — $A = \frac{1}{2}h\,(b_1 + b_2)$



Example: Trapezoid — $h = 7''$, $b_1 = 8''$, $b_2 = 5''$

$A = \frac{1}{2}h\,(b_1 + b_2)$
$A = (\frac{1}{2} \times 7)\,(8 + 5)$
$A = (\frac{7}{2})\,(13)$
$A = \frac{7}{2} \times \frac{13}{1}$
$A = \frac{91}{2}$
$A = 45\frac{1}{2}$ square inches

XV. How to calculate measurements of a circle (Figure 1)

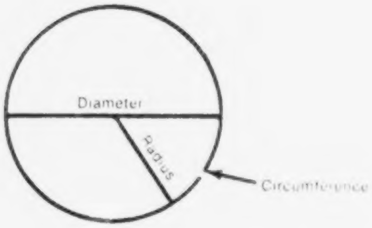
A. The diameter of a circle is equal to two times the radius, expressed as $D = 2R$

B. The radius of a circle is equal to half the diameter, expressed as $R = D/2$

C. The circumference of a circle is approximately equal to the diameter times 3.14, expressed as $C = 3.14D$ or $C = 3.14D$ or $C = \pi D$

D. The area of a circle is equal to the square of the radius times 3.14, expressed as $A = \pi R^2$

FIGURE 1

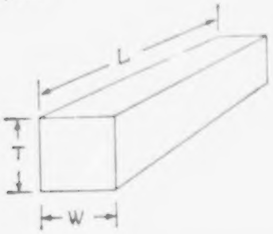


INFORMATION SHEET

XVI. Methods of sizing commonly used steel stock

A. Square bars are sized according to thickness and width and come in various lengths

Example:

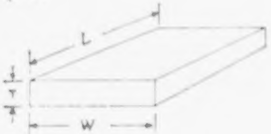


W	Width
T	Thickness 1/4" to 2 3/4", in graduations of 1/16" and 1/8"
L	Length 16', 20', 36'

Courtesy Lincoln Electric Company

B. Hot and cold-rolled flat bars are sized according to thickness and width and come in various lengths

Example:



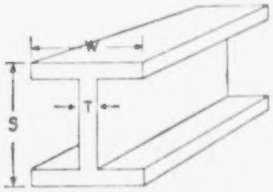
T	Thickness 1/4" to 1/2" in graduations of 1/16" 1/2" to 1 1/4" in graduations of 1/8" 1 1/4" to 2" in graduations of 1/4" (3/16" and lighter, see Strips)
W	Width 3/8" to 6" in graduations of 1/8" to 1/4"
L	Length 16', 36'

Courtesy Lincoln Electric Company

C. Structural H beams are sized according to height and width of beam

(NOTE: Structural H beams are also called WF beams to indicate that they are wide-flange beams, and the inside angle of the flange is parallel or almost parallel with top and bottom surfaces of the flange.)

Example:



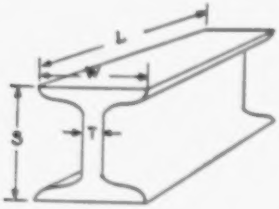
S	Size — 3", 4", 6" and larger
W	Width of flange
T	Thickness of web
L	Length 5' to 60'

INFORMATION SHEET

D. Structural I beams are sized according to height and width of beam and come in various lengths

(NOTE: Structural I beams are also called standard beams or S beams and are relatively easy to distinguish from H or wide beams because the inside angle always has a definite slope.)

Example:



S = Size
4 x 4
5 x 5
6 x 6

W = Width of flange — same as S

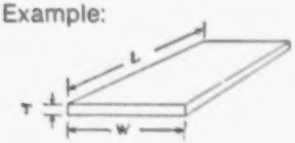
T = Thickness of web.

L = 5' to 60'.

Courtesy Lincoln Electric Company

E. Hot-rolled strips $^3/_{16}$" or less than in thickness are sized according to thickness and width and come in various lengths

Example:



T = Thickness — (thickness measurement expressed in fractions of an inch and gauge number).
3/16" (.1875")
No. 10 (.134"); 1/8" (.125");
No. 12 (.109"); No. 14 (.083");
No. 16 (.065"); No. 18 (.049");
No. 20 (.035"); No. 22 (.028").

W = Width
3/8" to 2" in graduations of 1/8".
2" to 3-1/2" in graduations of 1/4".
3-1/2" to 6" in graduations of 1/2".
6" to 12" in graduations of 1".

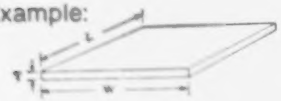
L = Length — 14' to 16'.

INFORMATION SHEET

F. Hot and cold-rolled sheets are sized according to thickness and width and listed by gauge number

(NOTE: Rolled steel 3/16" or less is classified as sheet, and over 3/16" is classified as plate.)

Example:



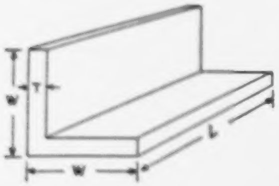
F = Thickness – 3/16" and less expressed according to gauge number.
3/16"
No. 8 (.1644"); No. 10 (.1345");
No. 11 (.1196"); No. 12 (.1046");
No. 14 (.0747"); No. 16 (.0598");
No. 18 (.0478"); No. 20 (.0359");
No. 22 (.0299"); No. 24 (.0239");
No. 26 (.0179"); No. 28 (.0149").

W = Width – measurements given in inches – 30", 36", 42", 48", 54", 60", 72", 84".

L = Length – measurements given in inches – 96", 120", 144", 156", 240".

G. Bar and structural angles are sized according to width times width times thickness and come in various lengths

Example:



W = Width
1/2" to 1-1/2" in graduations of 1/8" of flange.
1-1/2" to 2-1/2" in graduations of 1/4".
3" and over structural steel.

T = Thickness of flange 1/8" to 1/2" in graduations of 1/16".

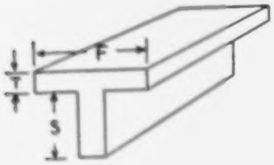
Angle stock is manufactured in unequal width of flanges, example: 2-1/2" x 1-1/2".

L = Length – 16', 18', 20'.

Courtesy Lincoln Electric Company

H. Bar and structural tees are sized according to flange width times stem times thickness and come in various lengths

Example:



F = Flange width
3/4" to 2-1/2" in graduations of 1/4".

S = Stem width
3/4" to 2-1/2" in graduations of 1/4".

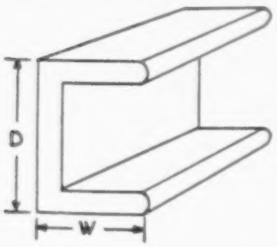
T = Thickness
1/8" to 3/8" in graduations of 1/16".

Courtesy Lincoln Electric Company

INFORMATION SHEET

I. Bar size channels are sized according to depth times width of flange times thickness of web and come in various lengths

Example:



D = Depth
1/2" to 3/4" in graduations of 1/16".
3/8" to 1-1/4" in graduations of 1/8".
1-1/4" to 2 " in graduations of 1/4".

W = Width (of flange) –
164, 5/16, 3/8, 6

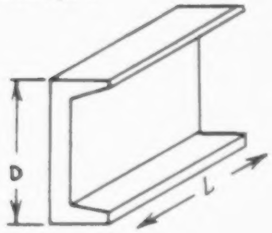
W = Width (of flange) –
1/4", 5/16", 3/8", 7/16", 1/2", 9/16", 3/4", 1".

T = Thickness of web – 1/8", 3/16", 1/4".

Courtesy Lincoln Electric Company

J. Structural channels are sized according to depth of channel and common sizes are 3", 4", 5", 6", 7", and 8"

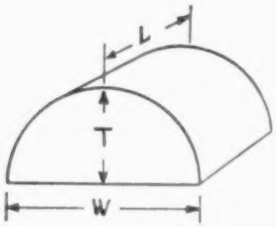
Example:



Common sizes are 3", 4", 5", 6", 7", and 8".

K. Hot-rolled half ovals are sized according to thickness and width and come in 16′ lengths

Example:



T = Thickness
3/8" to 1/2" in graduations of 1/16".

W = Width
1/8" to 1-1/4" in graduations of 1/8".
1-1/4" to 2" in graduations of 1/4".
2" to 3" in graduations of 1/2".

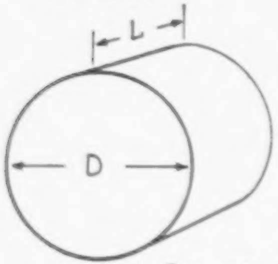
L = Length – 16′.

Courtesy Lincoln Electric Company

INFORMATION SHEET

L. Hot and cold-rolled rounds are sized according to length and diameter

Example:



D = Diameter 3/8" to 2" or larger in graduation increases of 1/16" and 1/8".

L = Length – 16', 18' and 20'.

Courtesy Lincoln Electric Company

Decimal Equivalent Chart

1/64	.015625	33/64	.515625
1/32	.03125	17/32	.53125
3/64	.046875	35/64	.546875
1/16	.0625	9/16	.5625
5/64	.078125	37/64	.578125
3/32	.09375	19/32	.59375
7/64	.109375	39/64	.609375
1/8	.125	5/8	.625
9/64	.140625	41/64	.640625
5/32	.15625	21/32	.65625
11/64	.171875	43/64	.671875
3/16	.1875	11/16	.6875
13/64	.203125	45/64	.703125
7/32	.21875	23/32	.71875
15/64	.234375	47/64	.734375
1/4	.25	3/4	.75
17/64	.265625	49/64	.765625
9/32	.28125	25/32	.78125
19/64	.296875	51/64	.796875
5/16	.3125	13/16	.8125
21/64	.328125	53/64	.828125
11/32	.34375	27/32	.84375
23/64	.359375	55/64	.859375
3/8	.375	7/8	.875
25/64	.390625	57/64	.890625
13/32	.40625	29/32	.90625
27/64	.421875	59/64	.921875
7/16	.4375	15/16	.9375
29/64	.453125	61/64	.953125
15/32	.46875	31/32	.96875
31/64	.484375	63/64	.984375
1/2	.5	1	1.

IW-313

Inches to Decimal Conversion Chart

Fractions of Inches	
1/16"	.0052
3/32"	.0078
1/8"	.0104
5/32"	.0130
3/16"	.0156
7/32"	.0182
1/4"	.0208
9/32"	.0234
5/16"	.0260
3/8"	.0313
7/16"	.0364
1/2"	.0417
9/16"	.0468
5/8"	.0521
11/16"	.0572
3/4"	.0625
13/16"	.0677
7/8"	.0729
15/16"	.0781

Inches	
1"	.0833
2"	.1667
3"	.2500
4"	.3333
5"	.4167
6"	.5000
7"	.5833
8"	.6667
9"	.7500
10"	.8333
11"	.9167
12"	1.0000

(Note: Do not confuse inches to decimal with decimal equivalents.)

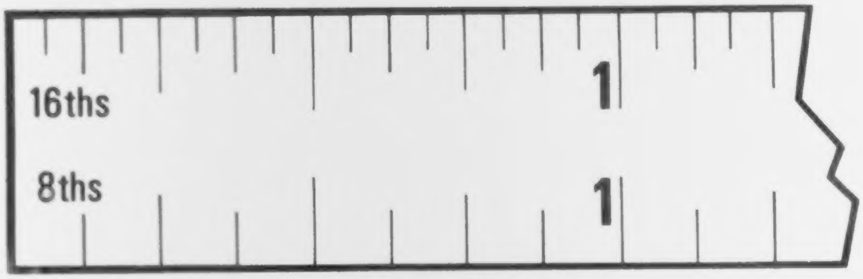
Fractional and Decimal Equivalents

unit tenths hundredths thousandths ten thousandths

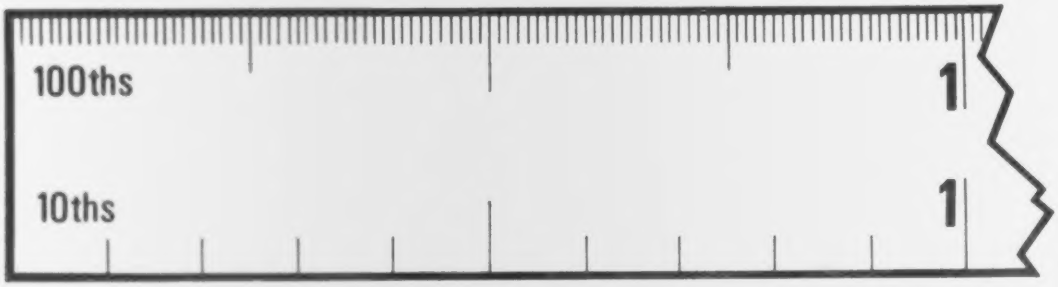
0.0000

FRACTION		DECIMAL		WORD
1/4	=	0.250	=	Two hundred fifty thousandths.
1/2	=	0.500	=	Five hundred thousandths.
7/8	=	0.875	=	Eight hundred seventy-five thousandths.
7/16	=	0.4375	=	Four hundred thirty-seven thousandths and five ten-thousandths.

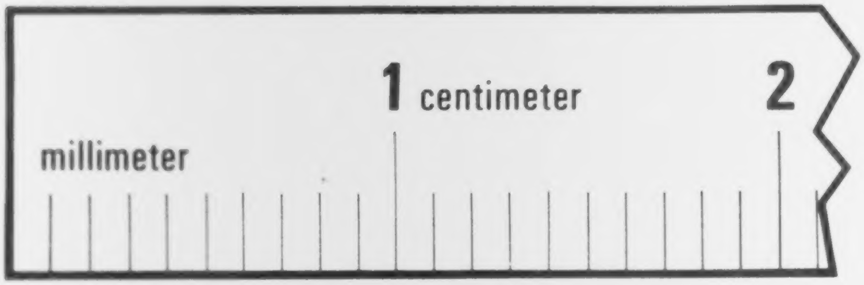
Units of Measurement
(Not to Scale)


16ths
8ths
1
1

Fractional Rule


100ths
10ths
1
1

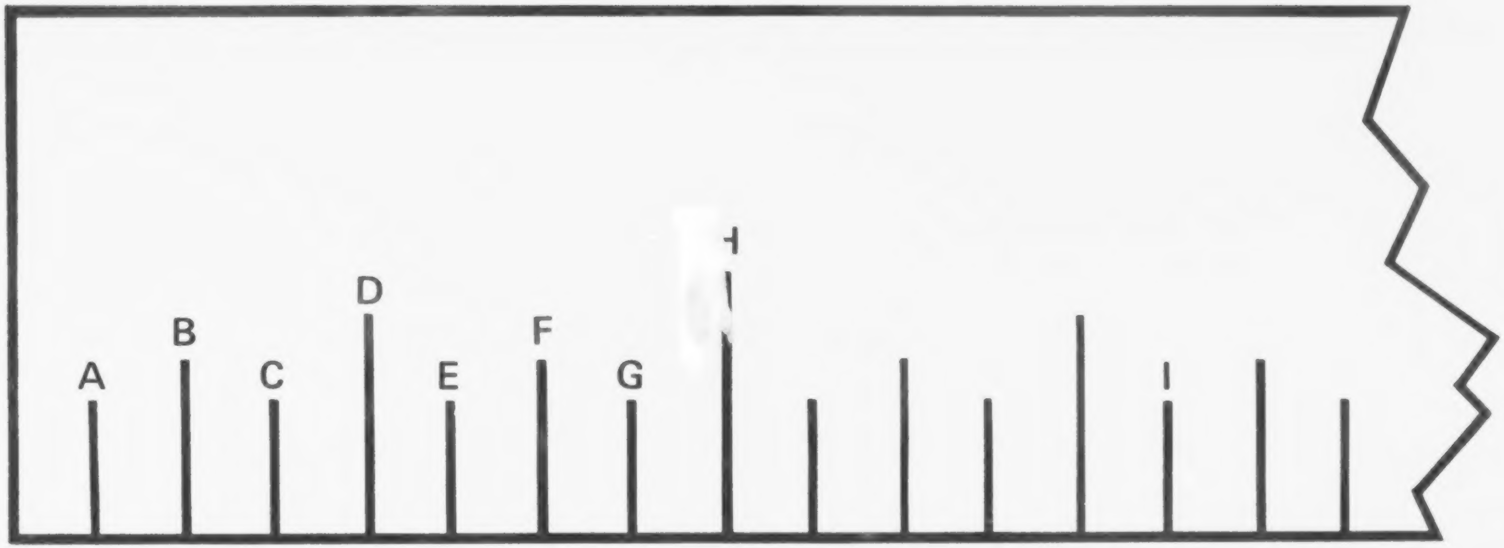
Decimal Rule


1 centimeter
2
millimeter

Metric Rule

Eighths Rule

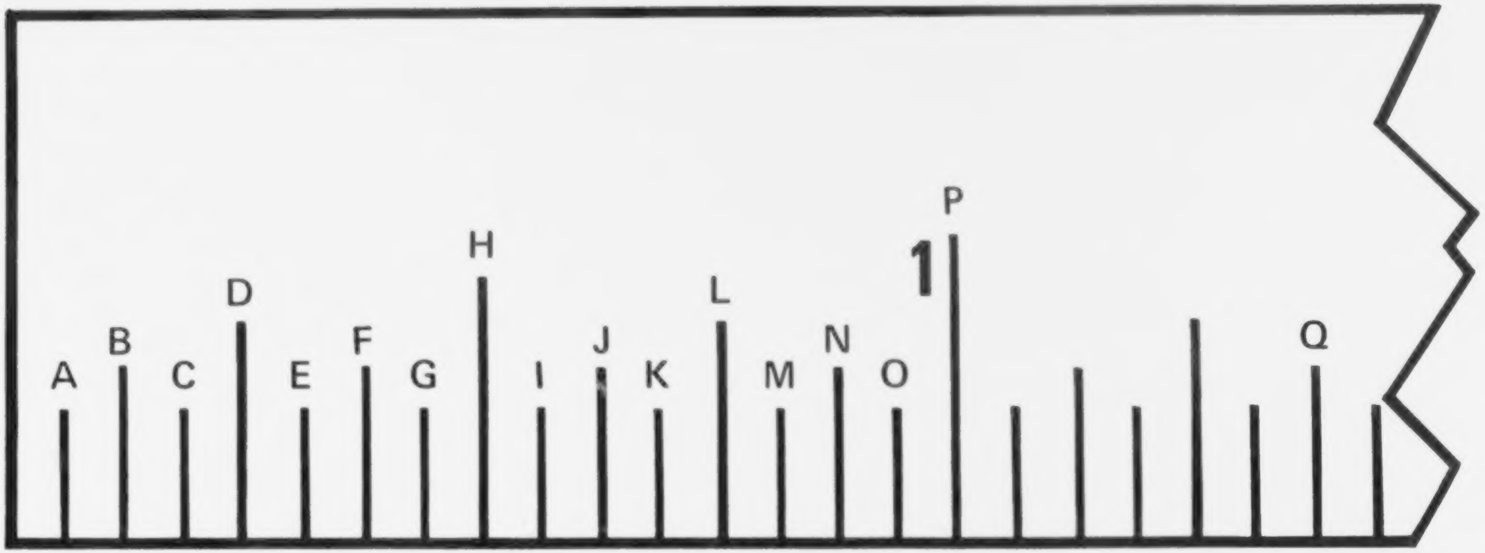
(Not to Scale)



A = 1/8, B = 2/8 = 1/4, C = 3/8, D = 4/8 = 1/2,
E = 5/8, F = 6/8 = 3/4, G = 7/8, H = 8/8 = 1,
I = 13/8 = 1 5/8

Sixteenths Rule

(Not to Scale)


A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
1
P
Q

A = 1/16, B = 2/16 = 1/8, C = 3/16, D = 4/16 = 1/4,
E = 5/16, F = 6/16 = 3/8, G = 7/16, H = 8/16 = 1/2,
I = 9/16, J = 10/16 = 5/8, K = 11/16, L = 12/16 = 3/4,
M = 13/16, N = 14/16 = 7/8, O = 15/16, P = 16/16 = 1,
Q = 22/16 = 1 6/16 = 1 3/8

BASIC MATH AND MEASURING
UNIT V

ASSIGNMENT SHEET #1 — ADD, SUBTRACT, MULTIPLY, AND DIVIDE FRACTIONS

Directions: Add, subtract, multiply, and divide fractions using the following procedures:

I. Procedure

A. To add fractions:

1. Change all fractions to a common denominator
2. Change all mixed numbers to improper fractions
3. Add all the numerators
4. Write down the total fraction
5. Reduce fraction to lowest terms in final form
6. If fraction totals to an improper fraction, simplify and reduce to lowest terms

Example #1:

Add:

$1/8 + 1/16 + 3/4 + 1/16 = 2/16 + 1/16 + 12/16 + 1/16$
Change to largest common denominator

$2/16 + 1/16 + 12/16 + 1/16 = 16/16 = 1$
Add numerators, place over common denominator, and reduce to lowest terms

Example #2:

Add:

$3/8 + 1/2 + 5/8 + 3/4 = 3/8 + 4/8 + 5/8 + 6/8$
Change to largest common denominator

$3/8 + 4/8 + 5/8 + 6/8 = 18/8 = 2\,2/8 = 2\,1/4$
Add numerators, place over common denominator, change from improper fraction to proper fraction, reduce to lowest terms

ASSIGNMENT SHEET #1

B. To subtract fractions:

1. Change all fractions to a common denominator
2. Change all mixed numbers to improper fractions
3. Subtract the numerators
4. Write down the remaining fraction
5. Reduce fraction to lowest terms in final form
6. If fraction totals to an improper fraction, simplify and reduce to lowest terms

Example #3:

Subtract:

$^{7}/_{8} - ^{9}/_{16} = ^{14}/_{16} - ^{9}/_{16} = ^{5}/_{16}$
Change to largest common denominator, subtract numerators, complete answer

Example #4:

Subtract:

$1\,^{3}/_{16} - ^{1}/_{4} = ^{19}/_{16} - ^{4}/_{16} = ^{15}/_{16}$
Change mixed number to improper fraction; change fractions to largest common denominator; subtract numerators; complete answer

Example #5:

Subtract:

$2\,^{3}/_{8} - 1\,^{5}/_{32} = ^{19}/_{8} - ^{37}/_{32} = ^{76}/_{32} - ^{37}/_{32} = ^{39}/_{32} = 1\,^{7}/_{32}$
Change mixed numbers to improper fraction; change fractions to largest common denominator; subtract numerators; change improper fraction to proper fraction; complete answer

C. To multiply fractions:

1. Multiply numerators
2. Multiply denominators
3. Write down new numerator over new denominator

ASSIGNMENT SHEET #1

4. Reduce fraction to lowest terms

5. If using mixed numbers, change fraction to improper fraction, multiply numerator and denominator, change to a mixed number, reduce fraction remainder to lowest terms

Example #6:

Multiply: $\frac{5}{8} \times \frac{1}{2} = \frac{5 \times 1}{8 \times 2} = \frac{5}{16}$

Multiply numerator, multiply denominator, complete answer

Example #7:

$$\frac{3}{4} \times 6 = \frac{3}{4} \times \frac{6}{1} = \frac{3 \times 6}{4 \times 1} = \frac{18}{4} = 4\frac{2}{4} = 4\frac{1}{2}$$

Multiply numerator by the whole number; multiply denominator by one; reduce to proper fraction; reduce to lowest terms; complete answer

Example #8:

$$23\frac{7}{16} \times 4 = (23 \times 4) + (\frac{7}{16} \times 4) = (92) + (\frac{7 \times 4}{16 \times 1})$$

$$= (92) + (\frac{28}{16}) = (92) + (1\frac{12}{16}) = (92) + (1\frac{3}{4}) = 93\frac{3}{4}$$

Multiply whole number of mixed number by whole number; multiply fractional part of mixed number numerator and denominator by whole number; reduce fractional part of mixed number to proper fraction and lowest terms; add whole numbers of each part; complete answer

Example #9:

$$1\frac{3}{4} \times 4\frac{3}{8} = \frac{7}{4} \times \frac{35}{8} = \frac{245}{32} = 7\frac{21}{32}$$

Change mixed numbers to improper fractions; multiply numerators and denominators; change improper fraction to proper fraction; complete answer

ASSIGNMENT SHEET #1

D. To multiply fractions with the cancellation method:

1. Extend the fractions on a common line
2. Cancel corresponding factors above and below the line
3. Multiply cancelled fractions

Example #10:

$$\frac{1}{2} \times \frac{4}{5} = \frac{1}{\underset{1}{\cancel{2}}} \times \frac{\overset{2}{\cancel{4}}}{5} = \frac{2}{5}$$

The fraction is reduced before multiplying and this helps avoid the use of larger numbers. Since 2 is a factor of 4, numerators and demoninators of the fractions can be reduced by cancellation and make the problem easier to work

E. To divide fractions:

1. Express fraction in division form
2. Invert numerator and denominator of dividing fraction
3. Multiply numerators and denominators
4. Reduce fractions to lowest terms
5. If answer is an improper fraction, change to proper fraction, and reduce to lowest terms

Example #11:

$$\frac{7}{8} \div \frac{1}{2} = \frac{\frac{7}{8}}{\frac{1}{2}} = \frac{7}{8} \times \frac{2}{1} = \frac{14}{8} = \frac{7}{4} = 1\frac{3}{4}$$

Write fraction in division form; invert division fraction; multiply numerators and denominators; change fraction from improper to proper fraction; reduce to lowest terms; complete answer

ASSIGNMENT SHEET #1

Example #12:

$$2\frac{1}{4} \div 1\frac{1}{8} \text{ or } \frac{2\frac{1}{4}}{1\frac{1}{8}} = \frac{\frac{9}{4}}{\frac{9}{8}} = \frac{9}{4} \times \frac{8}{9} = \frac{72}{36} = 2$$

Write fraction in either form; change to improper numbers for numerator and denominator; multiply numerators and denominators; change improper fraction to proper fraction; complete answer

II. Assignment (show all work)

A. Add the following:

1. $1/2 + 3/4 =$ ________________

2. $3/4 + 5/8 + 9/16 + 5/32 =$ ________________

3. $2\,1/2 + 3\,3/4 + 5\,5/8 + 3/8 =$ ________________

B. Subtract the following:

4. $7/8 - 3/4 =$ ________________

5. $1\,9/16 - 3/4 =$ ________________

6. $3\,3/8 - 1\,9/16 =$ ________________

C. Multiply the following:

7. $5/8 \times 3/4 =$ ________________

8. $5\,5/16 \times 4 =$ ________________

ASSIGNMENT SHEET #1

D. Divide the following:

9. $^3/_4 \div {}^3/_8 =$ __________________

10. $2^1/_2 \div 5 =$ __________________

BASIC MATH AND MEASURING
UNIT V

ASSIGNMENT SHEET #2 — ADD, SUBTRACT, MULTIPLY, AND DIVIDE DECIMAL EQUIVALENTS

Directions: Add, subtract, multiply, and divide decimal equivalents using the following procedures:

I. Procedure

A. To work decimal equivalents:

1. Write first decimal number
2. Write second decimal number under first decimal number

   (NOTE: Decimal points must be in line.)
3. If there are more than two decimal numbers, continue to list each in column order keeping the decimal points in line
4. Complete answer
5. Place decimal point in proper position for final answer

B. To add decimals:

Example #1:

$$\begin{array}{r} 0.9375 \\ +\ 0.5250 \\ \hline 1.4625 \end{array}$$

C. To subtract decimals:

Example #2:

$$\begin{array}{r} 0.3857 \\ -\ 0.0125 \\ \hline 0.3732 \end{array}$$

ASSIGNMENT SHEET #2

D. To multiply decimals:

Example #3:

$$\begin{array}{r} 0.2343 \\ \underline{\times\ 5} \\ 1.1715 \end{array}$$

(NOTE: Count over four decimals on completed answer for correct decimal positioning.)

E. To divide decimals

Example #4: $2.3865 \div 3 = $

$$\begin{array}{r@{}l} & \;0.7955 \\ 3 & \overline{)\,2.3865} \\ & \;\underline{2\,1} \\ & \;28 \\ & \;\underline{27} \\ & \;16 \\ & \;\underline{15} \\ & \;15 \\ & \;\underline{15} \end{array}$$

(NOTE: Indicate whole unit as zero or whole number before the decimal.)

II. Assignment

A. Add the following decimal equivalents:

1. 2.125 + 2.375 + 4.0625 + 9.0008 + 0.12 = ________________

2. 0.046 + 0.00002 + 0.653 + 8.1673 = ________________

3. 0.5000 + 0.015 + 0.171 + 8.7003 + 16.37 = ________________

B. Subtract the following decimal equivalents:

4. 8.763 − 0.041 = ________________

5. 126.373 − 126.219 = ________________

ASSIGNMENT SHEET #2

6. 9 − 0.125 = ________________

(NOTE: 9 = 9.000.)

C. Multiply the following decimal equivalents:

7. 0.9321 × 1.76 = ________________

8. 9.429 × 8.670 = ________________

D. Divide the following decimal equivalents:

9. 0.0672 ÷ 28 = ________________

10. 73.16 ÷ 24 = ________________

BASIC MATH AND MEASURING
UNIT V

ASSIGNMENT SHEET #3 — CONVERT FRACTIONS TO DECIMAL FORM

Directions: Convert fractions to decimal form, change fractions to a common denominator, reduce fraction to lowest terms using the following procedures:

I. Procedure

A. To convert fractions to decimal form:

Example #1:

$$\frac{1}{2} = \begin{array}{r} 0.500 \\ 2\,\overline{)1.000} \\ 1.000 \end{array} = 0.500$$

Example #2:

$$\frac{3}{4} = \begin{array}{r} 0.750 \\ 4\,\overline{)3.000} \\ \underline{28} \\ 20 \\ \underline{20} \\ 0 \end{array} = 0.750$$

Divide the denominator into the numerator; place the decimal in the correct position; use quotient as the answer

B. To change fractions to a common denominator:

Example #3:

$$\frac{1}{2} + \frac{1}{4} + \frac{5}{8} = \frac{1 \times 4}{2 \times 4} + \frac{1 \times 2}{4 \times 2} + \frac{5}{8} = \frac{4}{8} + \frac{2}{8} + \frac{5}{8} = \frac{11}{8} = 1\frac{3}{8}$$

ASSIGNMENT SHEET #3

Example #4:

$$\frac{1}{16} + \frac{3}{32} + \frac{5}{64} + \frac{3}{4} = \frac{1 \times 4}{16 \times 4} + \frac{3 \times 2}{32 \times 2} + \frac{5}{64} + \frac{3 \times 16}{4 \times 16}$$

$$= \frac{4}{64} + \frac{6}{64} + \frac{5}{64} + \frac{48}{64} = \frac{63}{64}$$

Using the largest denominator, place all fractions in the same base by multiplying both numerator and denominator by same base power; add all numerators; complete answer

(NOTE: Above examples did not have to be reduced to lowest terms, but Example #3 had to be changed from an improper to a proper fraction.)

C. To reduce a fraction to lowest terms:

Example #5:

$$\frac{6}{8} = \begin{matrix} 6 \div 2 & = 3 \\ 8 \div 2 & = 4 \end{matrix} = \frac{3}{4}$$

Example #6:

$$\frac{24}{32} = \begin{matrix} 24 \div 8 & = 3 \\ 32 \div 8 & = 4 \end{matrix} = \frac{3}{4}$$

Fraction is in lowest terms when numerator and denominator are divided by the greatest factor common to both

(NOTE: Fractions may be reduced by powers of 2 or by inspection for the greatest common divisor.)

II. Assignment

A. Convert the following fractions to decimal form. Show all work.

1. 1/2 = ____________________
2. 5/8 = ____________________
3. 1/4 = ____________________
4. 1/8 = ____________________
5. 5/16 = ____________________

ASSIGNMENT SHEET #3

6. $^{9}/_{16}$ = ____________________

7. $^{3}/_{4}$ = ____________________

8. $^{7}/_{8}$ = ____________________

9. $^{3}/_{8}$ = ____________________

10. $^{11}/_{16}$ = ____________________

B. Change the following fractions to a common denominator and solve. Show all work.

11. $^{1}/_{8} + ^{1}/_{4}$ = ____________________

12. $^{1}/_{16} + ^{5}/_{32} + ^{3}/_{8}$ = ____________________

13. $^{7}/_{8} + ^{9}/_{16} + 1\,^{1}/_{8} + ^{5}/_{32}$ = ____________________

14. $^{15}/_{64} - ^{1}/_{8}$ = ____________________

15. $^{7}/_{64} + ^{11}/_{16} + ^{9}/_{64} + ^{1}/_{8} + ^{7}/_{16} + ^{1}/_{4} + ^{3}/_{32}$ = ____________________

(NOTE: Answers 11-15 must be in proper or mixed number form.)

C. Reduce the following fractions to lowest terms.

16. $^{12}/_{16}$ = ____________________

17. $^{16}/_{24}$ = ____________________

18. $^{48}/_{64}$ = ____________________

19. $^{25}/_{75}$ = ____________________

20. $^{22}/_{64}$ = ____________________

21. $^{72}/_{128}$ = ____________________

22. $^{63}/_{56}$ = ____________________

23. $^{500}/_{800}$ = ____________________

24. $^{57}/_{48}$ = ____________________

25. $^{150}/_{200}$ = ____________________

(NOTE: Change improper fractions to proper form; then reduce to lowest terms.)

BASIC MATH AND MEASURING
UNIT V

ASSIGNMENT SHEET #4 — WRITE FRACTIONS AS DECIMALS AND PERCENTS

Directions: Write fractions as decimals and percents using the following procedures:

I. Procedure

A. Expressing fractions as decimals — divide the numerator by the denominator

Example: $\frac{5}{8}$

$$\begin{array}{r} .625 \\ 8\;\overline{)5.000} \\ \underline{4\,8} \\ 20 \\ \underline{16} \\ 40 \\ \underline{40} \end{array}$$

B. Expressing fractions as percents

1. Express the fraction in decimal form

2. Move the decimal point two places to the right

3. Place the % symbol after the number

Example: $\frac{7}{33}$

$$\begin{array}{r} .2121 = 21.21\% \\ 33\;\overline{)7.00} \\ \underline{6\,6} \\ 40 \\ \underline{33} \\ 70 \\ \underline{66} \\ 40 \\ \underline{33} \\ 7 \end{array}$$

(NOTE: Percent means that some number is being compared to 100.)

4. Multiply the numerator and denominator by that number which will change the denominator to 100

5. Drop the denominator

ASSIGNMENT SHEET #4

6. Add the % symbol

Example:

$$\frac{3}{4} = \frac{3}{4} \times \frac{25}{25} = \frac{75}{100} = 75\%$$

II. Assignment

A. Express each fraction as a decimal.

1. 1/8 ____________________
2. 1/4 ____________________
3. 1/2 ____________________
4. 3/4 ____________________
5. 5/8 ____________________
6. 7/20 ____________________
7. 7/16 ____________________
8. 1/9 ____________________
9. 4/9 ____________________
10. 4/5 ____________________

B. Express each fraction as a percent.

1. 1/4 ____________________
2. 2/9 ____________________
3. 7/10 ____________________
4. 3/4 ____________________
5. 2/2 ____________________
6. 9/11 ____________________
7. 1/3 ____________________

ASSIGNMENT SHEET #4

8. $^4/_9$ ________________

9. $^2/_6$ ________________

10. $^5/_8$ ________________

BASIC MATH AND MEASURING
UNIT V

ASSIGNMENT SHEET #5 — WRITE PERCENTS AS FRACTIONS AND DECIMALS

Directions: Write percents as fractions and decimals using the following procedures:

I. Procedure

  A. Expressing percents as fractions

    1. Drop the percent symbol

    2. Place the number over 100

    (NOTE: Reduce to simplest form.)

    Example:

$$38\% = \frac{38}{100} = \frac{19}{50}$$

  B. Expressing percents as decimals

    1. Drop the percent symbol

    2. Move the decimal point two places to the left

    Examples: 75% = .75 and $33\frac{1}{3}\%$ = .333

II. Assignment

  A. Express each percent as a fraction.

    1. 50% ______________

    2. 25% ______________

    3. $33\frac{1}{3}\%$ ______________

    4. 36% ______________

    5. 28% ______________

    6. $14\frac{2}{7}\%$ ______________

    7. 21% ______________

ASSIGNMENT SHEET #5

8. 45% ________________

9. 66 2/3% ________________

10. 70% ________________

B. Express each percent as a decimal.

1. 47% ________________

2. 15% ________________

3. 33.3% ________________

4. 62% ________________

5. 75% ________________

6. 3% ________________

7. 16.8% ________________

8. 9% ________________

9. 10% ________________

10. 50% ________________

BASIC MATH AND MEASURING
UNIT V

ASSIGNMENT SHEET #6 — WRITE DECIMALS AS FRACTIONS AND PERCENTS

Directions: Write decimals as fractions and percents by using the following procedures.

I. Procedure

A. Expressing decimals as fractions

1. If there is one decimal place, drop the decimal point and place the number over 10

Example: $.4 = \frac{4}{10} = \frac{2}{5}$

2. If there are two decimal places, drop the decimal point and place the number over 100

Example: $.75 = \frac{75}{100} = \frac{3}{4}$

3. If there are three decimal places, drop the decimal point and place the number over 1000

Example: $.375 = \frac{375}{1000} = \frac{3}{8}$

(NOTE: Do not forget to reduce to simplest form.)

B. Expressing decimals as percents

1. Move the decimal point two places to the right

2. Place the percent symbol after the number

Examples: 4 = 400%

.37 = 37%

II. Assignment

A. Express each decimal as a fraction.

1. .5 ________________

ASSIGNMENT SHEET #6

2. .8 ________________
3. .7 ________________
4. .25 ________________
5. .68 ________________
6. .55 ________________
7. .94 ________________
8. .375 ________________
9. .875 ________________
10. .212 ________________

B. Express each decimal as a percent.

1. .12 ________________
2. .19 ________________
3. .7 ________________
4. .29 ________________
5. .37 ________________
6. .42 ________________
7. .5 ________________
8. .523 ________________
9. .746 ________________
10. 3.75 ________________

BASIC MATH AND MEASURING
UNIT V

ASSIGNMENT SHEET #7 — MAKE CONVERSIONS WITH THE DECIMAL EQUIVALENT AND INCHES TO DECIMAL CONVERSION CHARTS

Directions: Write decimal equivalents as fractions and fractions as decimal equivalents by using the following procedures:

I. Procedure

   A. Observe the order of fraction listings from small to large sizes on the decimal equivalent chart

      (NOTE: If using a chart other than the one provided, ask the instructor to explain the chart.)

   B. Observe the order of decimal listings from small to large sizes

   C. Locate a fractional size and then locate the decimal equivalent directly to the right (usually connected by a bar or line)

   D. Using reverse order in item C, locate the decimal equivalent and read the fractional size directly to the left (usually connected by a bar or line)

II. Assignment

   A. Locate and list the decimal equivalent for the fractional sizes listed below:

      1. $^1/_{16}$ = ____________________

      2. $^7/_8$ = ____________________

      3. $^1/_4$ = ____________________

      4. $^1/_2$ = ____________________

      5. $^9/_{16}$ = ____________________

   B. Locate and list the fractional size for the decimal equivalents listed below:

      6. 0.4375 = ____________________

      7. 0.3125 = ____________________

      8. 0.375 = ____________________

ASSIGNMENT SHEET #7

9. 0.125 = ______________

10. .6875 = ______________

Directions: Convert feet and inches to decimals and convert decimals to feet and inches using the following procedures:

III. Procedure

A. Converting feet and inches to decimals

1. Determine total number of full feet and multiply by 1.000

   Example: To convert 5′ 7 1/2″ to decimals, first multiply 5 × 1.000 = 5.000

2. Determine total number of full inches and divide by 12, and add to total number of full feet

   Example: In converting 5′ 7 1/2″ to decimals, first multiply the 5′ by 1.000 = 5.000, then divide 7 by 12,

```
. .   . .5833
   12|7.000
. .   600
. .   100
. .   .96
. .   . .40
. .   . .36
. .   . . .40
```

then add .5833 to 5.000 = 5.5833

ASSIGNMENT SHEET #7

3. Determine fractions of inches in the measurement, divide the numerator (top number) by the denominator (bottom number), then divide that total by 12, and add this figure to the full feet and full inches

Example: The fractional ½" converts to a decimal by dividing 1 by 2,

```
 .  ..5000
   2|1.000
 .   10
 .  . 000
```

and then dividing .5000 by 12,

```
      .0417  (round off to 7)
   12|.5000
      48
       20
       12
        80
        84
and add the .0417 to  5.5833
                       .0417
                      5.6250
```

which makes 5.6250 the decimal conversion of 5' 7½"

B. Converting decimals to feet and inches

1. Convert the decimal figure to the left of the decimal point into full feet

Example: In the decimal measurement 5.6250', the 5 to the left of the decimal = 5'

2. Convert the decimal figure to the right of the decimal point into full inches by multiplying by 12,

```
..6250
 x.12
1.2500
6.250
7.5000
```

and then convert the decimal figure to the left of the decimal point into full inches

Example: In the decimal measurement 7.500, the 7 to the left of the decimal = 7"

ASSIGNMENT SHEET #7

3. Convert the remaining decimal figure to fractions of an inch by multiplying by 1.000 and reducing it to its lowest terms

   Example: When the decimal measurement .5000 is multiplied by 1.000, the result is .5, so to convert this, drop the decimal point and place the figure over 10 to get 5/10, then reduce this figure to its lowests terms to get 1/2" so that the decimal measurement of 5.6250 = 5' 7 1/2"

   (NOTE: If the figure has two numbers to the right of the decimal point, place it over 100 instead of 10, so the figure .56 would be 56/100.)

IV. Assignment

(NOTE: Be sure to follow rules for rounding off figures.)

A. Convert the following feet and inches to decimals

11. 9' 6 3/4" = ____________________

12. 3' 4 5/8" = ____________________

13. 14' 2 1/4" = ____________________

14. 1' 6" = ____________________

B. Convert the following decimals to feet and inches

15. 2.5000' = ____________________

16. 8.6333' = ____________________

17. 11.7425' = ____________________

18. 17.1125' = ____________________

ASSIGNMENT SHEET #7

Decimal Equivalent Chart

Fraction	Decimal	Fraction	Decimal
1/64	.015625	33/64	.515625
1/32	.03125	17/32	.53125
3/64	.046875	35/64	.546875
1/16	.0625	9/16	.5625
5/64	.078125	37/64	.578125
3/32	.09375	19/32	.59375
7/64	.109375	39/64	.609375
1/8	.125	5/8	.625
9/64	.140625	41/64	.640625
5/32	.15625	21/32	.65625
11/64	.171875	43/64	.671875
3/16	.1875	11/16	.6875
13/64	.203125	45/64	.703125
7/32	.21875	23/32	.71875
15/64	.234375	47/64	.734375
1/4	.25	3/4	.75
17/64	.265625	49/64	.765625
9/32	.28125	25/32	.78125
19/64	.296875	51/64	.796875
5/16	.3125	13/16	.8125
21/64	.328125	53/64	.828125
11/32	.34375	27/32	.84375
23/64	.359375	55/64	.859375
3/8	.375	7/8	.875
25/64	.390625	57/64	.890625
13/32	.40625	29/32	.90625
27/64	.421875	59/64	.921875
7/16	.4375	15/16	.9375
29/64	.453125	61/64	.953125
15/32	.46875	31/32	.96875
31/64	.484375	63/64	.984375
1/2	.5	1	1.

ASSIGNMENT SHEET #7

Inches to Decimal Conversion Chart

Fractions of Inches

1/16"------------- .0052
3/32" ------------------- .0078
1/8"------------- .0104
5/32" ------------------- .0130
3/16"------------- .0156
7/32" ------------------- .0182
1/4"------------- .0208
9/32" ------------------- .0234
5/16"------------- .0260
3/8" ------------------- .0313
7/16"------------- .0364
1/2" ------------------- ..0417
9/16"------------- .0468
5/8" ------------------- .0521
11/16"------------- .0572
3/4" --------------------.0625
13/16"--------- .0677
7/8" --------------------.0729
15/16"--------- .0781

Inches

1"---------.0833
2"---------.1667
3"---------.2500
4"---------.3333
5"---------.4167
6"---------.5000
7"---------.5833
8"---------.6667
9"---------.7500
10"--------.8333
11"--------.9167
12"--------1.0000

BASIC MATH AND MEASURING
UNIT V

ASSIGNMENT SHEET #8 — USE THE ENGLISH-METRIC CONVERSION CHART

Directions: Compute problems by using the following procedures:

I. Procedure

   A. Observe the three columns provided on the English-Metric conversion chart

   B. Observe the left column titled "When You Know"

   C. Observe the middle column titled "You Can Convert To"

   D. Observe the right column titled "When You Multiply By"

   E. Use the chart to solve problems of conversion

II. Assignment — Locate the conversion factor and compute the following problems. Show all work.

   1. The wall thickness of a piece of steel tubing is $^{1}/_{64}$". How many centimeters thick is the steel tubing?

   2. A piece of steel round bar is 16′ long. How many meters long is the round bar?

   3. A bag of flux weighs fifty pounds. How many kilograms does the bag of flux weigh?

ASSIGNMENT SHEET #8

ENGLISH-METRIC CONVERSION CHART

	When You Know	You Can Convert To	When You Multiply By
LENGTH	Inches	Millimeters (mm)	25.4
	Millimeters	Inches	0.04
	Inches	Centimeters (cm)	2.54
	Centimeters	Inches	0.4
	Inches	Meters (m)	0.0254
	Meters	Inches	39.37
	Feet	Centimeters	30.5
	Centimeters	Feet	4.8
	Feet	Meters	0.305
	Meters	Feet	3.28
	Miles	Kilometers (km)	1.61
	Kilometer	Miles	0.62
AREA	Inches^2	Millimeters^2 (mm^2)	645.2
	Millimeters^2	Inches^2	0.0016
	Inches^2	Centimeters^2 (cm^2)	6.45
	Centimeters^2	Inches^2	0.16
	Foot^2	Meters^2 (m^2)	0.093
	Meters^2	Foot^2	10.76

ASSIGNMENT SHEET #8

ENGLISH-METRIC CONVERSION CHART

CAPACITY-VOLUME	Ounces	Milliliters (ml)	30
	Milliliters	Ounces	0.034
	Pints	Liters (l)	0.47
	Liters	Pints	2.1
	Quarts	Liters	0.95
	Liters	Quarts	1.06
	Gallons	Liters	3.8
	Liters	Gallons	0.26
	Cubic Inches	Liters	0.0164
	Liters	Cubic Inches	61.03
	Cubic Inches	Cubic Centimeters (cc)	16.39
	Cubic Centimeters	Cubic Inches	0.061
WEIGHT (MASS)	Ounces	Grams	28.4
	Grams	Ounces	0.035
	Pounds	Kilograms	0.45
	Kilograms	Pounds	2.2
FORCE	Ounce	Newtons (N)	0.278
	Newtons	Ounces	35.98
	Pound	Newtons	4.448
	Newtons	Pound	0.225
	Newtons	Kilograms (kg)	0.102
	Kilograms	Newtons	9.807

ASSIGNMENT SHEET #8

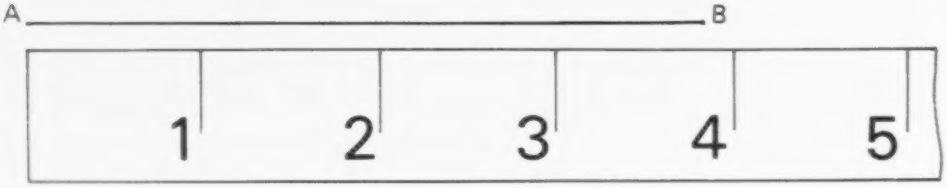
ENGLISH-METRIC CONVERSION CHART

	When You Know	You Can Convert To	When You Multipy By
ACCELERATION	Inch/Sec^2	Meter/Sec^2	.0254
	Meter/Sec^2	Inch/Sec^2	39.37
	Foot/Sec^2	Meter/Sec^2 (m/s^2)	0.3048
	Meter/Sec^2	Foot/Sec^2	3.280
TORQUE	Pound-Inch (Inch Pound)	Newton-Meters (N-M)	0.113
	Newton-Meters	Pound-Inch	8.857
	Pound-Foot (Foot-Pound)	Newton-Meters	1.356
	Newton-Meters	Pound-Foot	.737
PRESSURE	Pound/sq. in. (PSI)	Kilopascals (kPa)	6.895
	Kilopascals	Pound/sq. in.	0.145
	Inches of Mercury (Hg)	Kilopascals	3.377
	Kilopascals	Inches of Mercury (Hg)	0.296
FUEL PERFORMANCE	Miles/gal	Kilometers/liters (km/l)	0.425
	Kilometers/liters	Miles/gal	2.352
VELOCITY	Miles/hour	Kilometers/hr (km/h)	1.609
	Kilometers/hour	Miles/hour	0.621
TEMPERATURE	Degrees Fahrenheit	Degrees Celsius	5/9 (F°-32)
	Degrees Celsius	Degrees Fahrenheight	9/5(C°)+32=F°

BASIC MATH AND MEASURING
UNIT V

ASSIGNMENT SHEET #9 — MEASURE DISTANCES WITH 1", ½", AND ¼" GRADUATIONS

1. a. Point A, on line segment AB below, is at the end of the rule. Point B is nearest what number? ____________



b. Is AB exactly 4 inches long? ____________

c. Is AB exactly 3 inches long? ____________

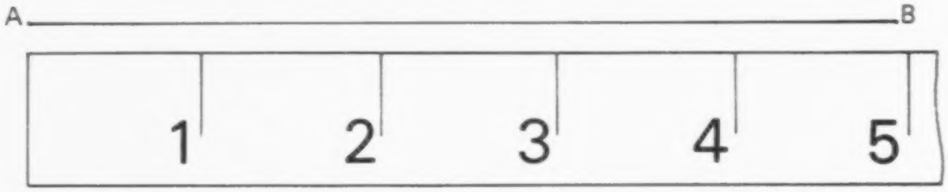
(NOTE: All measurements are approximate.)

d. AB above is approximately ____________ inches in length.

e. All measurements are ____________

f. Would a measurement less than a full inch be exact on this rule? ____________

2. a. Is AB below exactly 5 inches long? ____________



b. Is the measure of AB closer to 4 inches or 5 inches? ____________

c. Can this rule normally be used to measure with complete accuracy? ____________

d. All measurement is (exact, approximate). Circle the correct word.

e. Always measure to the ____________ ____________ marked on the ruler.

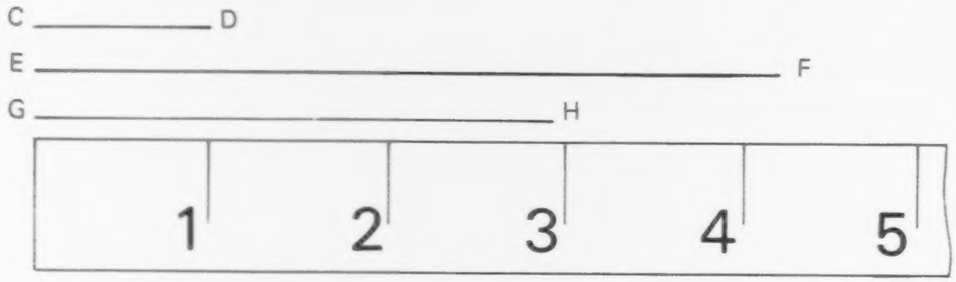
ASSIGNMENT SHEET #9

3. On the rule below, give the measure of each line segment to the nearest mark. Label your answers with the correct unit of measure.

   a. CD = ____________

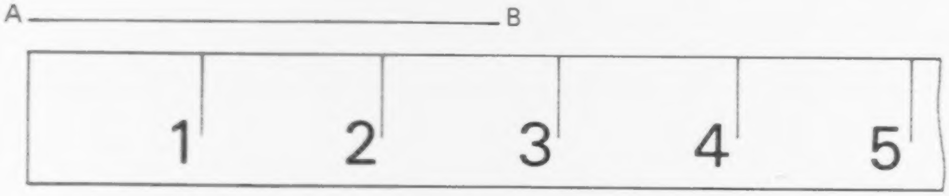
   b. EF = ____________

   c. GH = ____________



   d. Are the measurements above exact or approximate? ____________

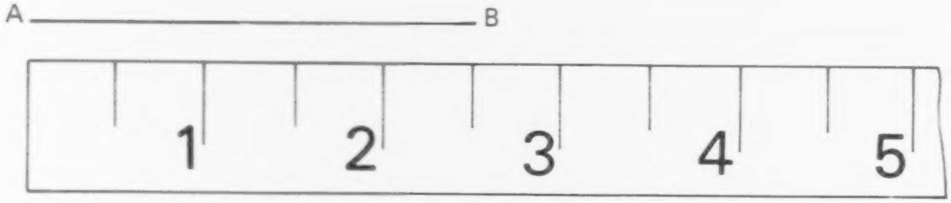
4.



   a. Is 3 inches an accurate measure for AB above? ____________

   b. Could we get a more accurate measure of AB if we divided the inches into smaller units? ____________

5. a. Into how many parts has each inch been divided on the rule below?

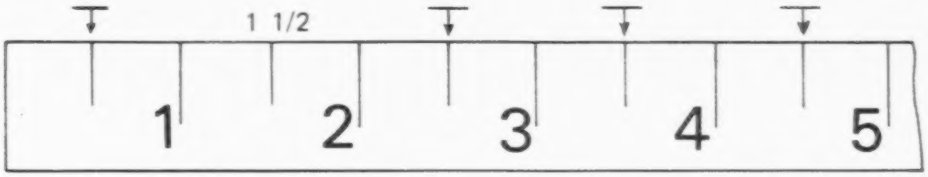


   b. Is B located nearer 2, 2 1/2, or 3 inches? ____________

   (NOTE: Remember, always read to the nearest mark on a rule.)

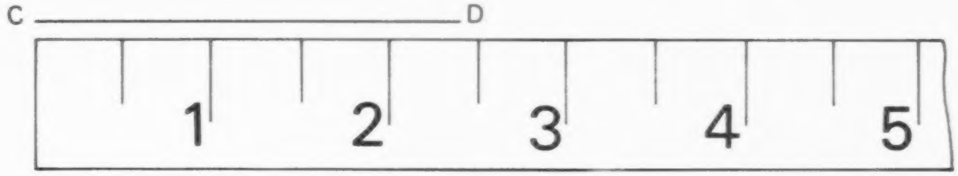
ASSIGNMENT SHEET #9

6. Write in the missing numbers.



7. a. Is point D below nearer 2 or 2 ½? ____________

b. Therefore, using this rule, the measure of CD is approximately ____________ inches.

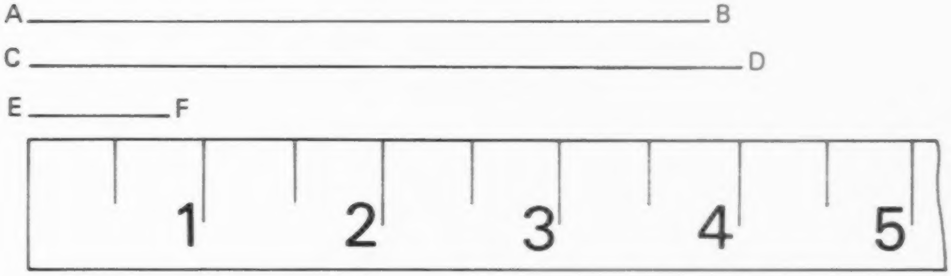


8. To measure a line segment, line up one of its end points with the end of the rule. Give the approximate measure of each segment shown below.

a. AB = ____________

b. CD = ____________

c. EF = ____________

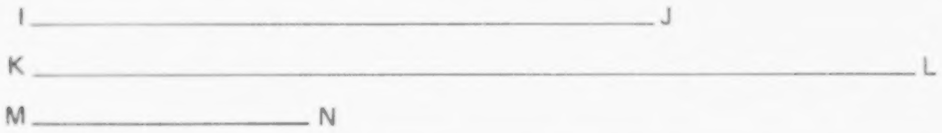


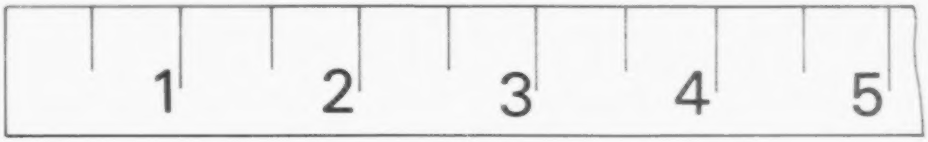
d. Although the measures given above are correct, are they exact?

____

ASSIGNMENT SHEET #9

9. Give the measure of each line segment below:





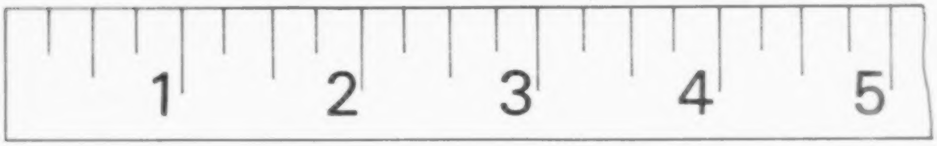
a. IJ = ____________

b. KL = ____________

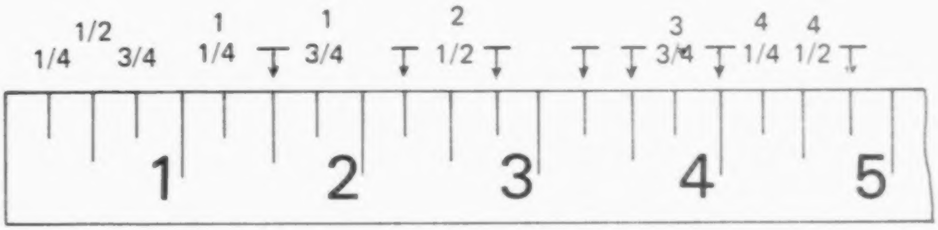
c. MN = ____________

10. a. To get a still more accurate measurement, divide ½-inches into two smaller units. Since ½ ÷ 2 = ¼, the new marks would be ____________ of an inch apart.

b. Each inch on the rule below is divided into how many parts? ____



11. Fill in the missing names.


1/4
1/2
3/4
1 1/4
1 3/4
2 1/2
3 3/4
4 1/4
4 1/2
1
2
3
4
5

BASIC MATH AND MEASURING
UNIT V

ASSIGNMENT SHEET #10 — MEASURE DISTANCES WITH ${}^{1}/_{4}$" AND ${}^{1}/_{8}$" GRADUATIONS

Measures should be written as whole numbers, if possible. If not possible, write them as a whole number and a fraction. The fraction should be in lowest terms. For example, ${}^{1}/_{2}$ is preferred to ${}^{4}/_{8}$ or ${}^{8}/_{16}$.

1. Circle the preferred measurement in each of the pairs below.

   a. $5\,{}^{6}/_{8}$ or $5\,{}^{3}/_{4}$

   b. ${}^{1}/_{2}$ or ${}^{6}/_{12}$

   c. $1\,{}^{8}/_{16}$ or $1\,{}^{1}/_{2}$

   d. $7\,{}^{4}/_{16}$ or $7\,{}^{1}/_{4}$

   e. $3\,{}^{2}/_{8}$ or $3\,{}^{1}/_{4}$

2. Write the following measures in simplest form.

   Example: $2\,{}^{10}/_{16} = 2\,{}^{5}/_{8}$

   a. $2\,{}^{8}/_{16}$

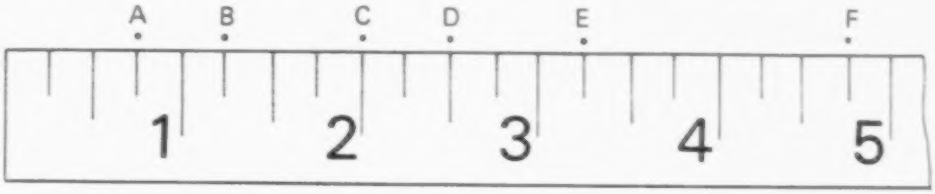
   b. $1\,{}^{6}/_{8}$

   c. $2\,{}^{8}/_{8}$

   d. $7\,{}^{14}/_{16}$

   e. $3\,{}^{3}/_{16}$

3. Give the preferred measurement for each of the points shown below.



   a. Point A: ____________

   b. Point B: ____________

ASSIGNMENT SHEET #10

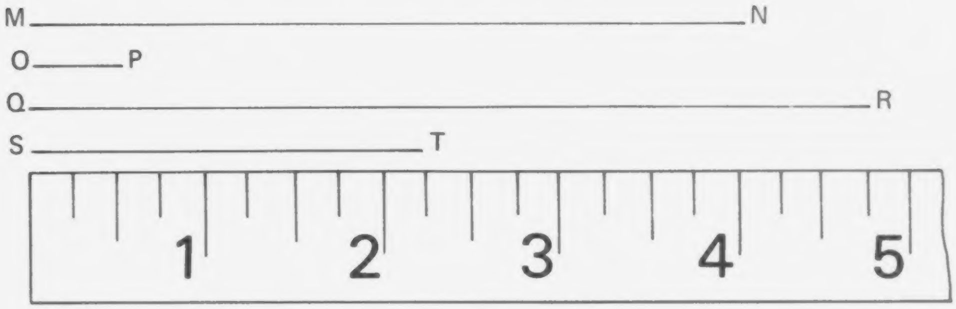
c. Point C: __________

d. Point D: __________

e. Point E: __________

f. Point F: __________

4. Give the measures of these line segments.


M
N
O
P
Q
R
S
T
1
2
3
4
5

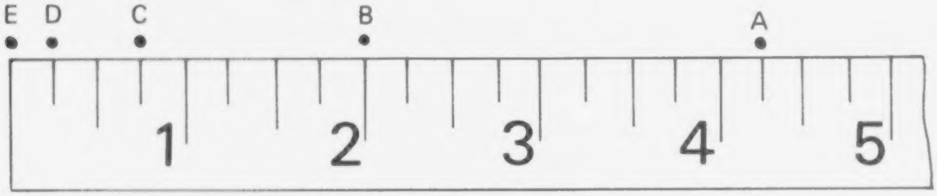
a. MN = __________

b. OP = __________

c. QR = __________

d. ST = __________

5. Which point on the rule below represents zero? __________


E
D
C
B
A
1
2
3
4
5

ASSIGNMENT SHEET #10

6.

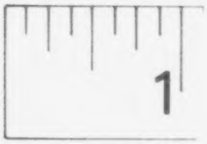


Figure A

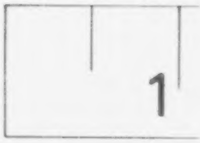


Figure B

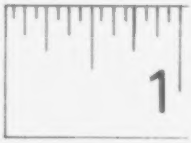


Figure C

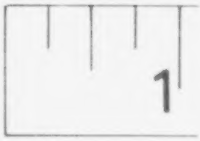


Figure D

a. In Figure A, the inch has been divided into ____________ parts.

b. In Figure B, the inch has been divided into ____________ parts.

c. In Figure C, the inch has been divided into ____________ parts.

d. In Figure D, the inch has been divided into ____________ parts.

e. When the inch is divided into two equal parts, each part is called a ____________.

f. When the inch is divided into four equal parts, each part is called a ____________.

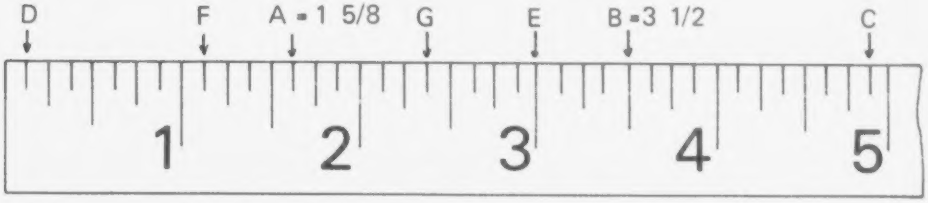
g. There are ____________ halves in 1 inch.

h. There are ____________ fourths in 1 inch.

7. a. Each inch on the rule shown below is divided into ____________ equal parts.

b. These equal parts are called ____________ of an inch.

c. How many eights are in one inch? ____________



ASSIGNMENT SHEET #10

8. Give the reading of these points on the preceeding rule.

   a. Point C: ____________

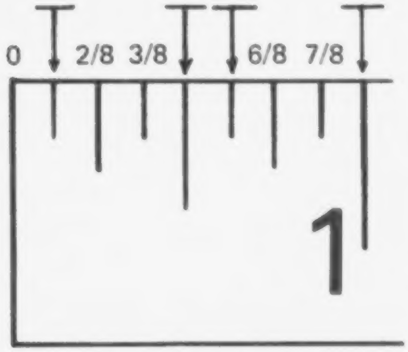
   b. Point D: ____________

   c. Point E: ____________

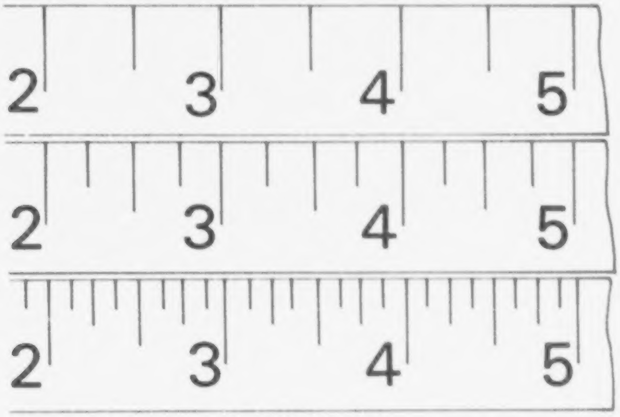
   d. Point F: ____________

   e. Point G: ____________

9. What fractions are missing? (Write all answers as eighths.)



10. In the figure below are three rules. One is divided into halves, one into fourths, and the other into eighths. Use these to answer the questions below.



   a. 3 1/2 = 3 /4 = 3 /8

   b. 2 1/4 = 2 /8

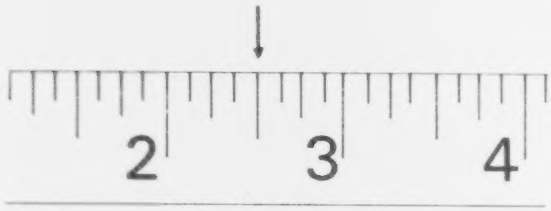
   c. 3 3/4 = 3 /8

ASSIGNMENT SHEET #10

11. The arrow in the figure below points to a mark that can be read as 2 $^4/_8$. Give two other names for this point.

a. ____________

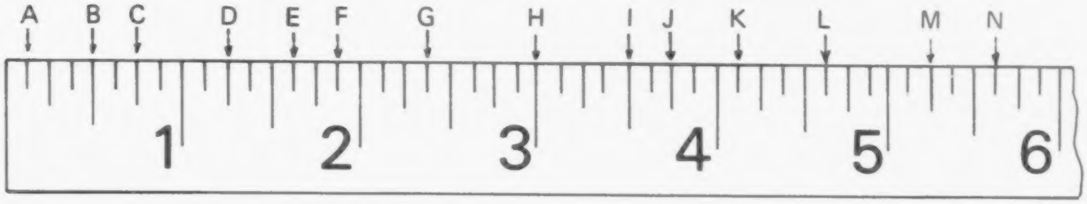
b. ____________



BASIC MATH AND MEASURING
UNIT V

ASSIGNMENT SHEET #11 — MEASURE DISTANCES WITH 1/8" GRADUATIONS

1. Use the drawing below and give the reading of the indicated points. Be sure answers are in lowest terms.



a.	h.
b.	i.
c.	j.
d.	k.
e.	l.
f.	m.
g.	n.

2. Use the drawing above to find the distance between the following letters. Give answers in lowest terms.

   a. F to H

   b. D to E

   c. A to C

   d. I to J

   e. B to H

   f. B to I

   g. H to K

   h. B to C

   i. K to L

   j. H to M

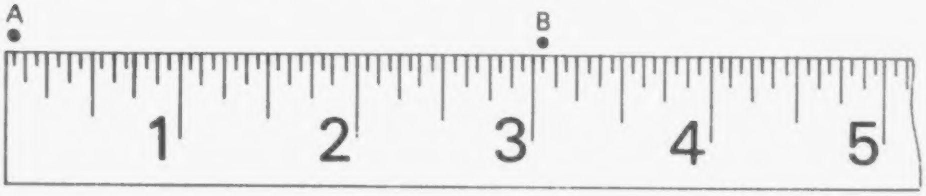
BASIC MATH AND MEASURING
UNIT V

ASSIGNMENT SHEET #12 — MEASURE DISTANCES WITH 1/16" GRADUATIONS

1. a. Each inch on the rule below is divided into ____________ equal parts.

   b. Each small unit represents what fraction of an inch? ____________

   c. How many sixteenths are there in an inch? ____________



   d. How far is point A from the zero end of the rule? ____________

   e. How far is point B from the zero end of the rule? ____________

2. a. How many 1/2-inch units are in an inch? ____________

   b. How many 1/8-inch units are in an inch? ____________

   c. How many 1-inch units are in an inch? ____________

   d. How many 1/4-inch units are in an inch? ____________

   e. How many 1/16-inch units are in an inch? ____________

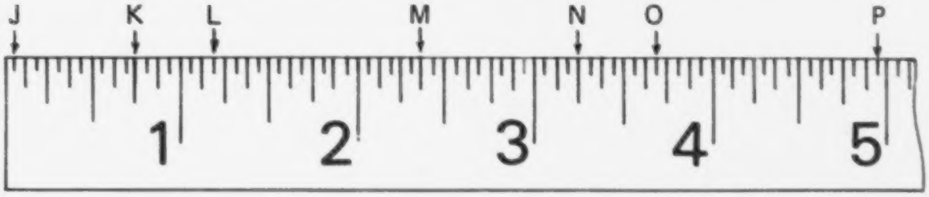
ASSIGNMENT SHEET #12

3. a. Each inch on the rule shown below is divided into __________ equal parts.

   b. Each part is called a __________ of an inch.

   c. There are how many sixteenths in one inch? __________

   d. There are how many sixteenths in one-half inch?__________



4. Use the preceding rule to answer these questions. Are these measures correct? Answer yes or no for each one.

   a. J: 1/16 __________

   b. K: 1/2 __________

   c. L: 1 3/16 __________

   d. M: 2 3/8 __________

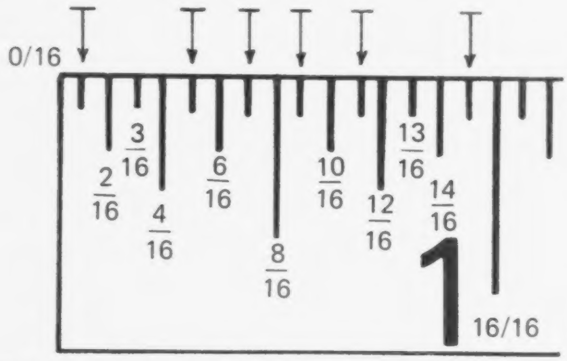
   e. N: 3 1/8 __________

   f. O: 3 11/16 __________

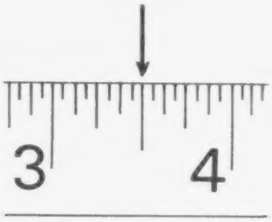
   g. P: 4 7/8 __________

ASSIGNMENT SHEET #12

5. a. Name the missing fractions below:

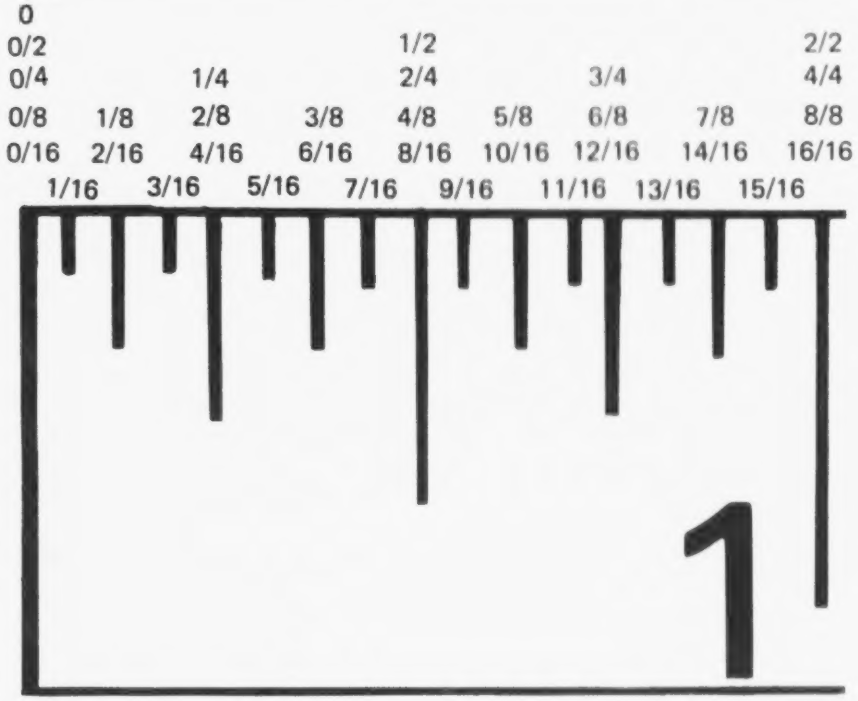

0/16
2/16
3/16
4/16
6/16
8/16
10/16
12/16
13/16
14/16
1
16/16

b. The point marked on the rule below could be named 3 8/16. It could also be named 3 /8, /4, or 3 /2



ASSIGNMENT SHEET #12

6. The rule below shows that 1/4, 2/8, and 4/16 are all names for the same point on the rule.


0
0/2
0/4
0/8
0/16
1/16
1/8
2/16
3/16
1/4
2/8
4/16
5/16
3/8
6/16
7/16
1/2
2/4
4/8
8/16
9/16
5/8
10/16
11/16
3/4
6/8
12/16
13/16
7/8
14/16
15/16
2/2
4/4
8/8
16/16
1

a. Another name for 2/16 is ______________.

b. Other names for 12/16 are ______________.

c. Other names for 1 inch are ______________.

d. Another name for 6/16 is ______________.

e. The simplest name for 10/16 is ______________.

f. 12/16 reduced to lowest terms is ______________.

g. At the left end of the rule is the ______________ point.

h. Are the fractions 1/16, 3/16, 5/16, 7/16, 9/16, 11/16, 13/16, and 15/16 in simplest form? ______________

ASSIGNMENT SHEET #12

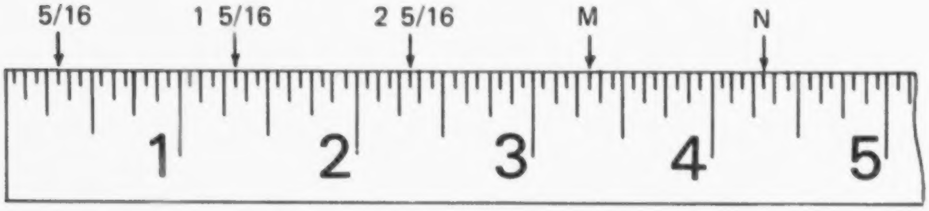
7. a. The rule below is divided into (16ths, 32nds). Circle the correct answers.

b. The first five units on this rule represents $^5/_{16}$ of an inch. Five small units to the right of the 1-inch mark is the mark representing 1 $/_{16}$ inches.

c. Five small units to the right of the 2-inch mark is the mark representing 2 $/_{16}$ inches.

d. Give the reading of point M. ____________

e. Give the reading of point N. ____________



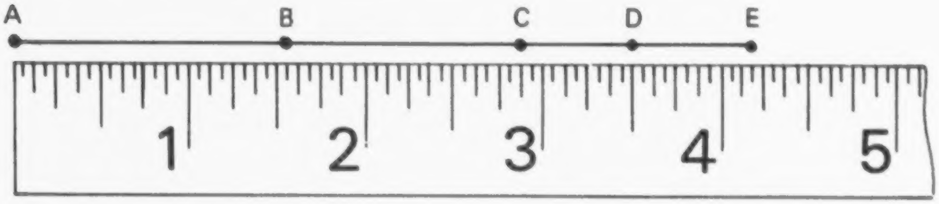
8. What are the measures of the following segments?

a. AB = ____________

b. AC = ____________

c. AD = ____________

d. AE = ____________



ASSIGNMENT SHEET #12

9. What is the length of JK in:

(REMEMBER: Read the rule to the nearest mark.)

a. Figure A ______________

b. Figure B ______________

c. Figure C ______________

d. Figure D ______________

e. Figure E ______________

f. Which figure shows the rule that would give the most accurate measure of JK? ______________

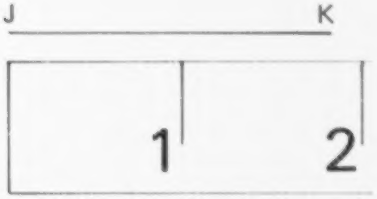


Figure A

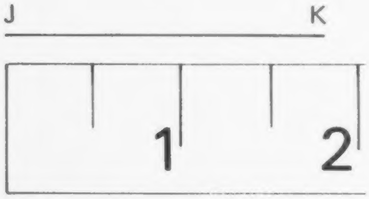


Figure B

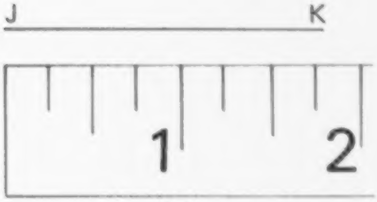


Figure C

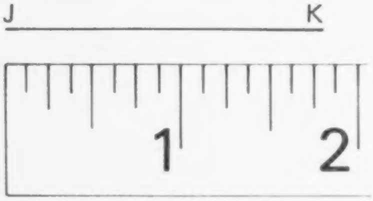
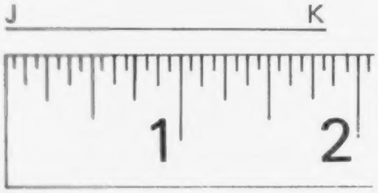


Figure D

Figure E



ASSIGNMENT SHEET #12

10. Give the measure of each segment shown below.

    a. JK = ____________

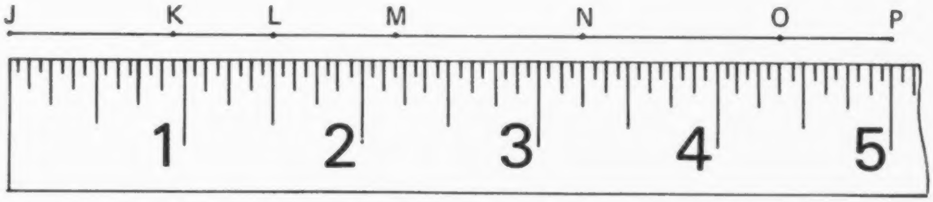
    b. JL = ____________

    c. JM = ____________

    d. JN = ____________

    e. JO = ____________

    f. JP = ____________


J
K
L
M
N
O
P
1
2
3
4
5

11. Give the simplest reading for each position on the enlarged rule shown below:

    a. Q: ____________

    b. R: ____________

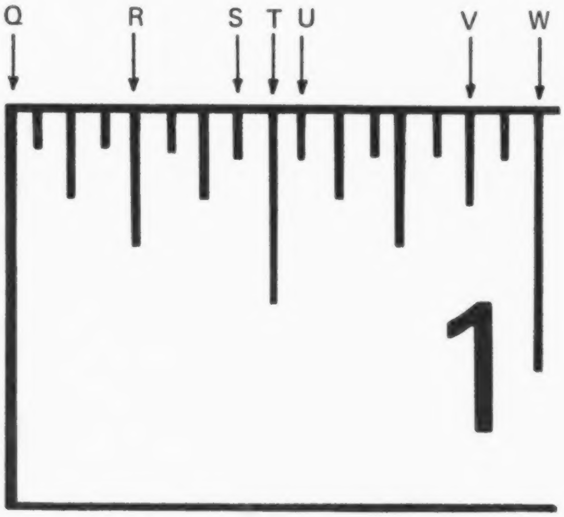
    c. S: ____________

    d. T: ____________

    e. U: ____________

    f. V: ____________

    g. W: ____________



ASSIGNMENT SHEET #12

12. Which figure below shows a rule marked off in

a. Fourths ____________

b. Inches ____________

c. Eighths ____________

d. Halves ____________

e. Sixteenths ____________

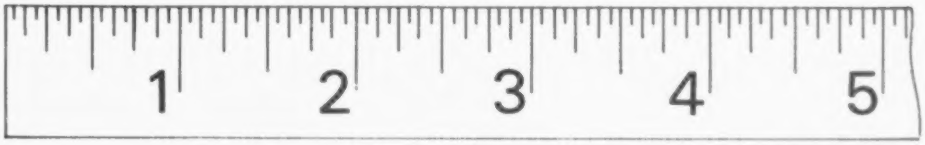


Figure A

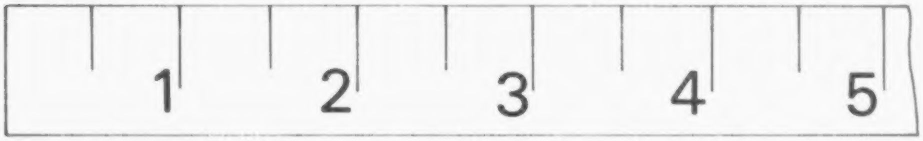


Figure B

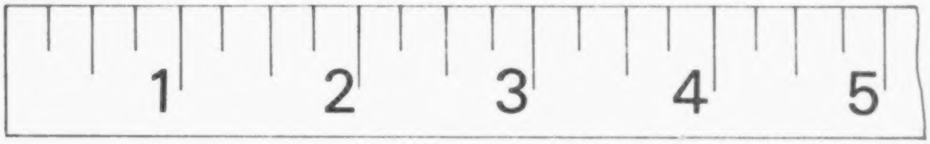


Figure C

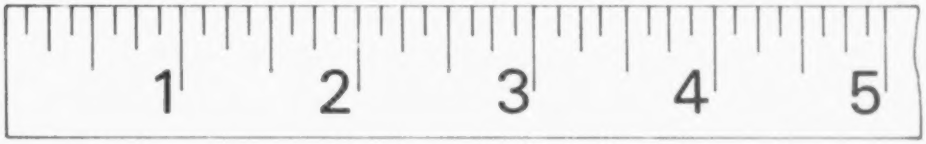


Figure D

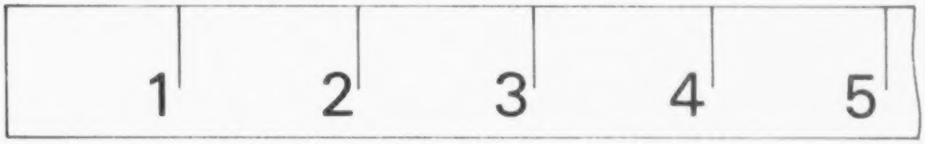
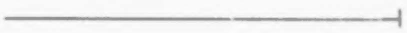


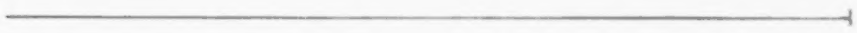
Figure E

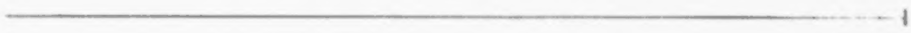
BASIC MATH AND MEASURING
UNIT V

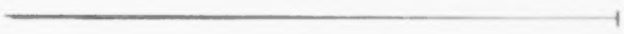
ASSIGNMENT SHEET #13 — MEASURE GIVEN LINE SEGMENTS WITH 1/16" GRADUATIONS

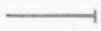
Directions: Using a 1/16 inch scale rule, measure the following line segments. Write the measure above each segment. State your answer in simplest form.

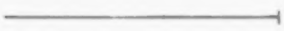
1.


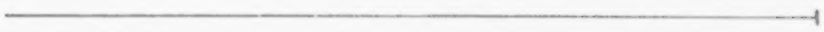
2.


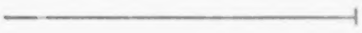
3.


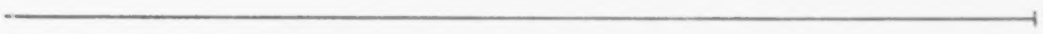
4.


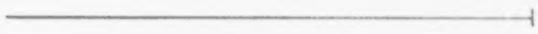
5.


6.


7.


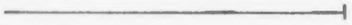
8.


9.


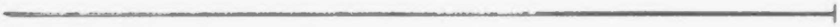
10.


ASSIGNMENT SHEET #13

11.



12.



BASIC MATH AND MEASURING
UNIT V

ASSIGNMENT SHEET #14 — MEASURE DIMENSIONS OF GIVEN OBJECTIVES WITH A RULE

1. Use your rule to get the indicated measures in simplest form. In the sketch at the right, find the measure of:

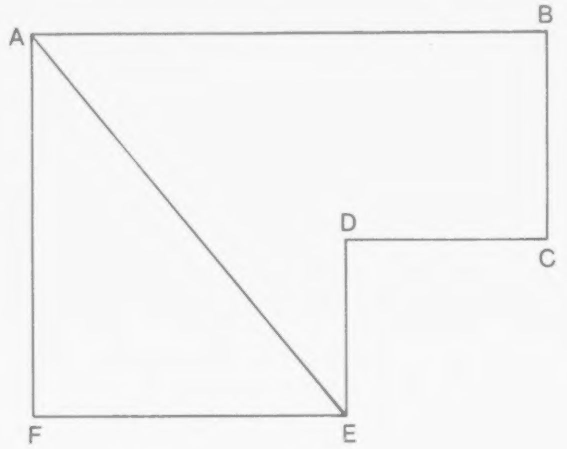
   a. AB = ____________

   b. BC = ____________

   c. DE = ____________

   d. AF = ____________

   e. AE = ____________



2. In the sketch at the right, find the measures of:

   a. IH = ____________

   b. IG = ____________

   c. GE = ____________

   d. JK = ____________

   e. KC = ____________

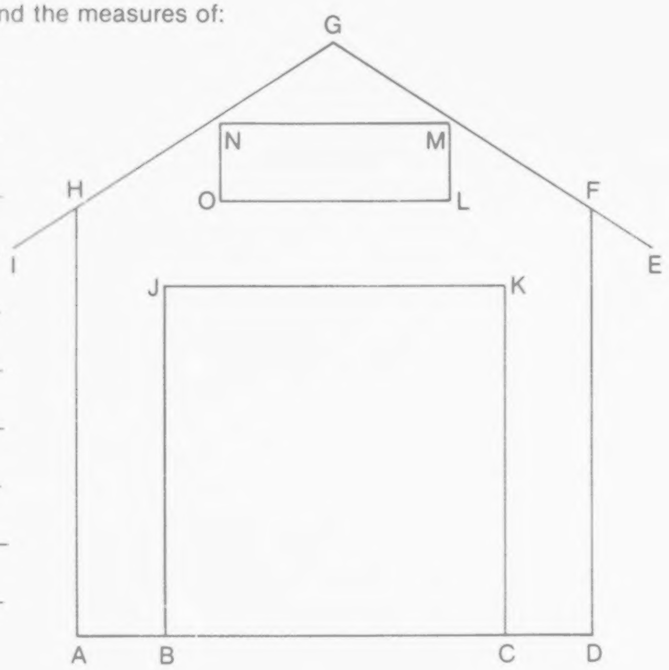
   f. CD = ____________

   g. HA = ____________

   h. FD = ____________

   i. NM = ____________

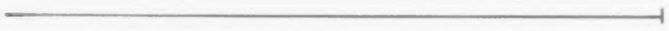
   j. ML = ____________

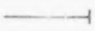


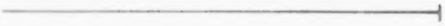
BASIC MATH AND MEASURING
UNIT V

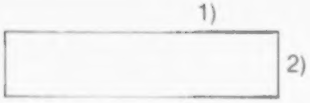
ASSIGNMENT SHEET #15 — MEASURE GIVEN LINES AND OBJECTS WITH A RULE

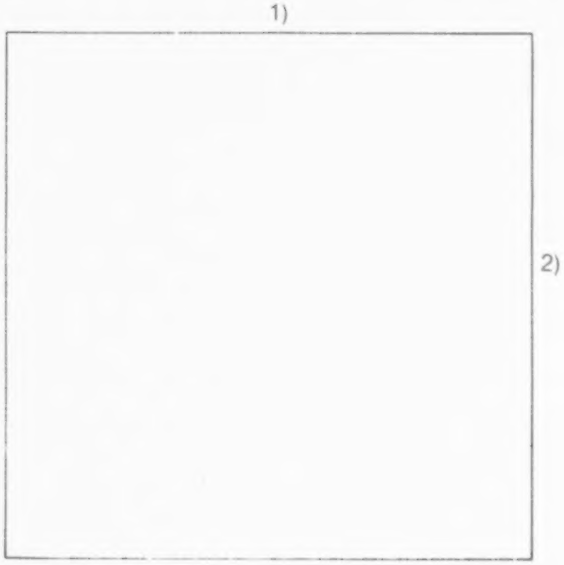
1. Using a 1/16 inch scale rule, measure the following objects.

a. 

b. 

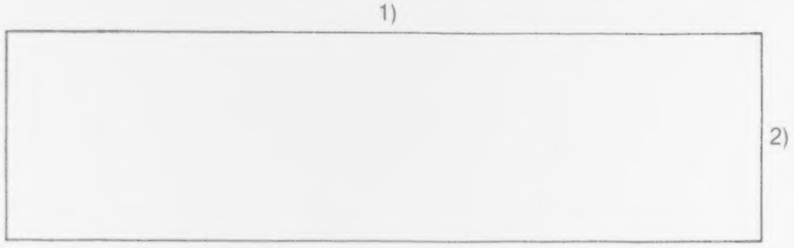
c. 

d. 

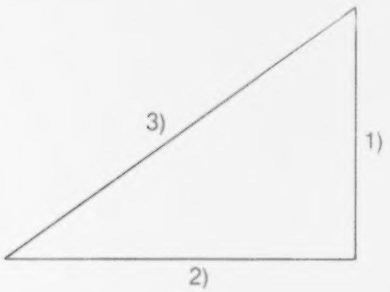
e. 

ASSIGNMENT SHEET #15

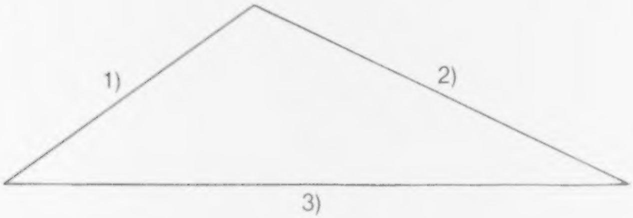
f.



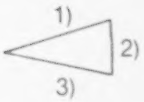
g.



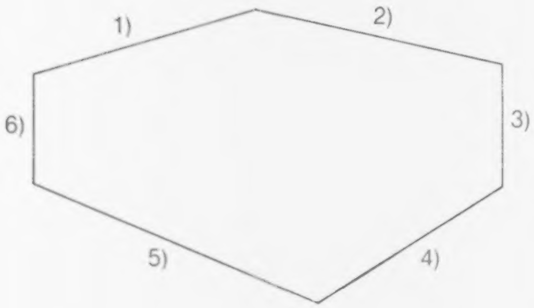
h.



i.



j.



BASIC MATH AND MEASURING
UNIT V

ASSIGNMENT SHEET #16 — USE A RULE TO DRAW LINES AND OBJECTS TO GIVEN SPECIFICATIONS

1. Draw a straight line segment:
    a. 5 inches long
    b. 3 $^1/_2$ inches long
    c. 1 $^5/_8$ inches long
    d. $^{15}/_{16}$ inches long
    e. 2 $^3/_4$ inches long
2. Draw a square with each side 1 $^1/_2$ inches.
3. Draw a rectangle with two sides 3 $^1/_4$ inches and two sides 1 $^3/_4$ inches.

BASIC MATH AND MEASURING
UNIT V

ASSIGNMENT SHEET #17 — FIND THE MID-POINT OF GIVEN LINES AND FIGURES

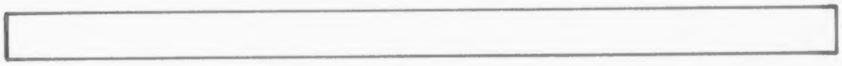
1. a. How long is the line above? ____________

   b. $4\,{}^{5}/_{8} \times {}^{1}/_{2} = {}^{37}/_{8} \times {}^{1}/_{2} = {}^{37}/_{16} =$ ____________

   c. What is the length of half of the line above? ____________

   d. Mark the mid-point of the line. Measure to be sure both parts are the same length

2.

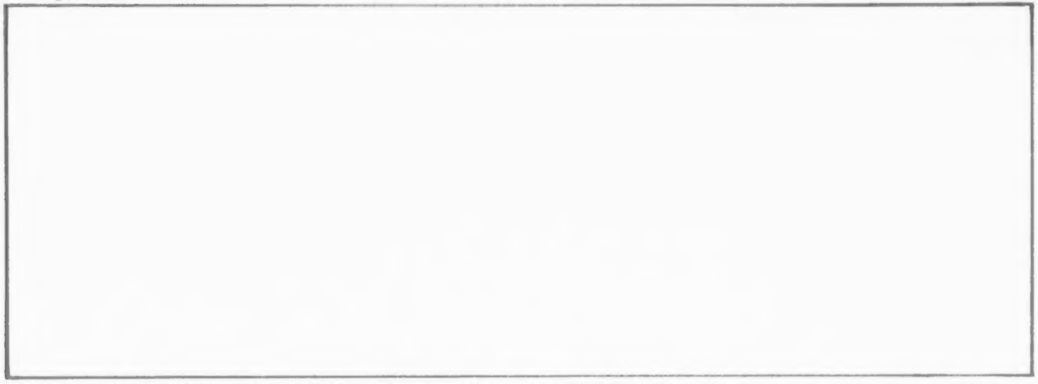


   a. What is the length of the bar above? ____________

   b. What is one-half the length of the bar? ____________

   c. Draw a line showing where the cut would be made to get two pieces each half as long as the original piece.

3.



   a. How long is the piece of aluminum above? ____________

   b. What is half its length? ____________

   c. Draw the cutting line on the figure. (You will need to mark the mid-point on each of the long sides and draw the line connecting these two points.)

   d. How wide is the piece of aluminum? ____________

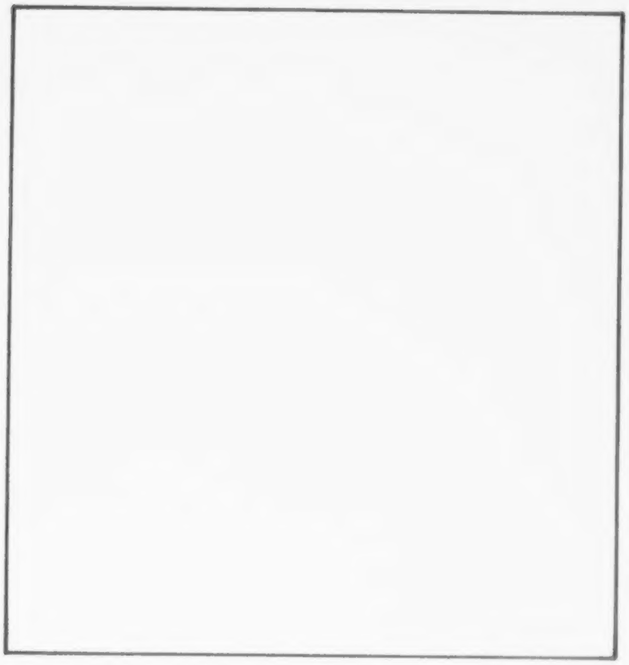
ASSIGNMENT SHEET #17

e. What is half its width? ____________

f. Draw the cutting line that would divide the width in half. (Remember to mark the mid-points of both widths and connect these two points.)

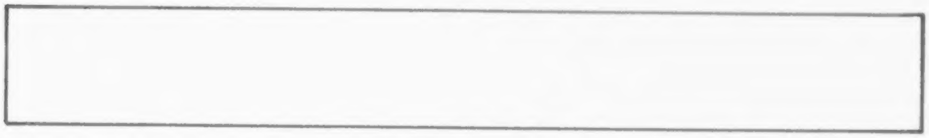
g. The point where the two lines cross is the center of the aluminum. If you were supposed to drill a hole in the center of the piece in item 3, where would you place the hole? Circle the point on the drawing.

4.



Perform the steps to locate and mark the point where you would drill a hole in the center of this figure.

5.



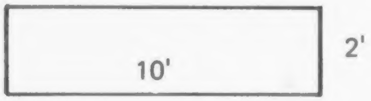
Mark the cutting line for cutting the length of the bar in half.

BASIC MATH AND MEASURING
UNIT V

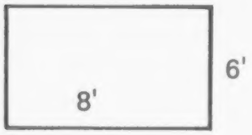
ASSIGNMENT SHEET #18 — CALCULATE THE PERIMETERS OF GIVEN RECTANGLES

Directions: Calculate the perimeters for the following rectangles. Write the formula on each problem.

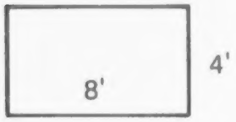
1.



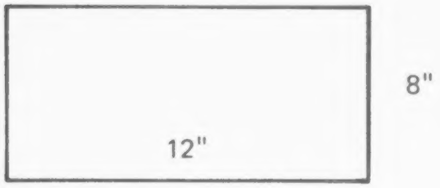
2.



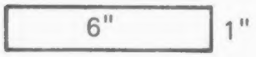
3.



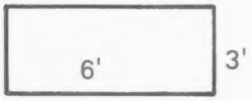
4.



5.



6.



7. L = 15", W = 8"
8. L = 2 1/2", W = 2"
9. L = 8", W = 6 1/4"
10. L = 3 1/4", W = 6"

ASSIGNMENT SHEET #18

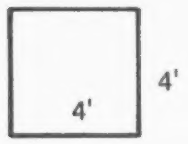
11. L = 1 mile, W = 1/2 mile
12. L = 8 yards, W = 3 yards
13. L = 4", W = 4 1/2"
14. L = 8 1/4', W = 15 3/4'
15. L = 12', W = 7'

BASIC MATH AND MEASURING
UNIT V

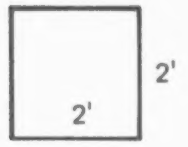
ASSIGNMENT SHEET #19 — CALCULATE THE PERIMETERS OF GIVEN SQUARES

Directions: Calculate the perimeter for each of the following squares. Write the formula for each problem.

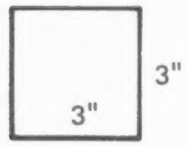
1.



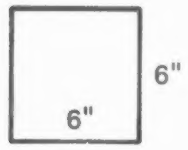
2.



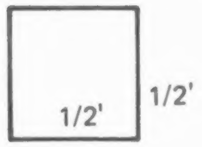
3.



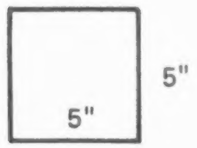
4.



5.



6.



ASSIGNMENT SHEET #19

7. s = 8″

8. s = 7″

9. s = 10 1/2″

10. s = 7.2″

11. s = 3/4″

12. s = 2″

13. s = 10 1/2″

14. s = 1/4″

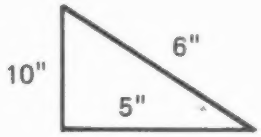
15. s = 1/2″

BASIC MATH AND MEASURING
UNIT V

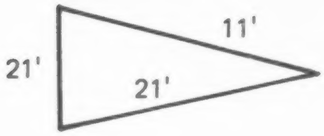
ASSIGNMENT SHEET #20 — CALCULATE THE PERIMETERS OF GIVEN TRIANGLES

Directions: Calculate the perimeter for each of the following triangles. Write the formula for each problem.

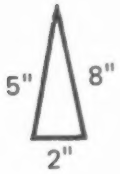
1.



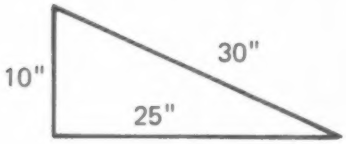
2.



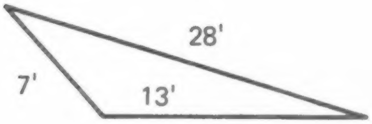
3.



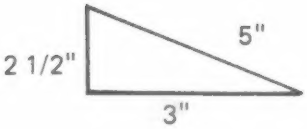
4.



5.



6.



ASSIGNMENT SHEET #20

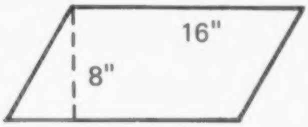
7. $s_1 = 3\ 3/4'$, $s_2 = 5'$, $s_3 = 5'$
8. $s_1 = 2\ 1/8'$, $s_2 = 5\ 1/8'$, $s_3 = 9'$
9. $s_1 = 8\ 1/2'$, $s_2 = 2\ 1/4'$, $s_3 = 23\ 1/4'$
10. $s_1 = 12'$, $s_2 = 18'$, $s_3 = 16'$
11. $s_1 = 5\ 1/4''$, $s_2 = 4''$, $s_3 = 4''$
12. $s_1 = 7.2'$, $s_2 = 13.1'$, $s_3 = 3.4'$
13. $s_1 = 4''$, $s_2 = 7''$, $s_3 = 7''$
14. $s_1 = .1'$, $s_2 = .3'$, $s_3 = .5'$
15. $s_1 = 7\ 1/20'$, $s_2 = 8\ 1/10'$, $s_3 = 2'$

BASIC MATH AND MEASURING
UNIT V

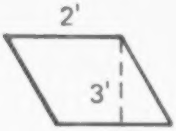
ASSIGNMENT SHEET #21 — CALCULATE THE AREAS OF GIVEN PARALLELOGRAMS

Directions: Calculate the area for each parallelogram.

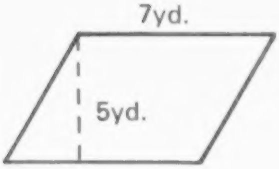
1.



2.



3.



4. b = $4\frac{1}{2}$ miles, h = $5\frac{1}{3}$ miles

5. b = 1.7′, h = 4.2′

6. b = 8″, h = $2\frac{1}{2}$″

7. b = 106′, h = 12′

8. b = $10\frac{1}{3}$″, h = $1\frac{1}{5}$″

9. b = $13\frac{1}{6}$′, h = 12′

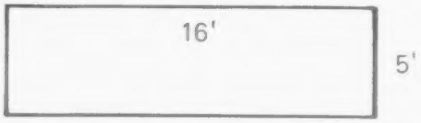
10. b = 12.3 yards, h = 1.1 yards

BASIC MATH AND MEASURING
UNIT V

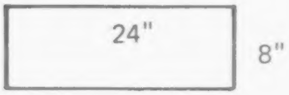
ASSIGNMENT SHEET #22 — CALCULATE THE AREAS OF GIVEN RECTANGLES

Directions: Calculate the area for each rectangle.

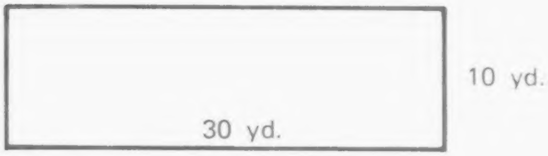
1\.



2\.



3\.



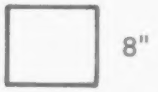
4. l = 8″, w = 2 1/2″
5. l = 10 1/4′, w = 8 1/2′
6. l = 4.6 yards, w = 8.4 yards
7. l = 10 1/2″, w = 8 1/4″
8. l = 6.5 miles, w = 7.15 miles
9. l = 4.75′, w = 3.1′
10. l = 12.2″, w = 8″

BASIC MATH AND MEASURING
UNIT V

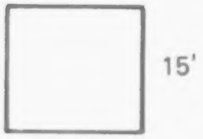
ASSIGNMENT SHEET #23 — CALCULATE THE AREAS OF GIVEN SQUARES

Directions: Calculate the area for each square.

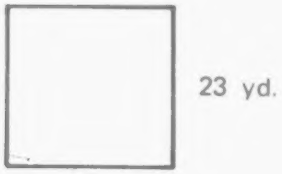
1.



2.



3.



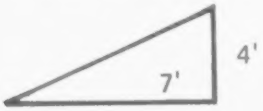
4. s = 10 1/2 miles
5. s = 6 1/3 feet
6. s = 8.7 yards
7. s = 1.42"
8. s = 9 2/3"
9. s = 14.8'
10. s = 1/8 miles

BASIC MATH AND MEASURING
UNIT V

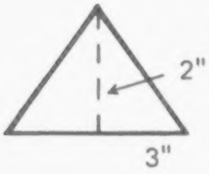
ASSIGNMENT SHEET #24 — CALCULATE THE AREAS OF GIVEN TRIANGLES

Directions: Calculate the area for each triangle.

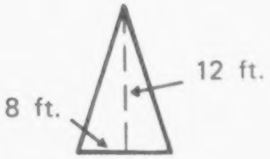
1.



2.



3.

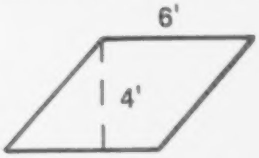


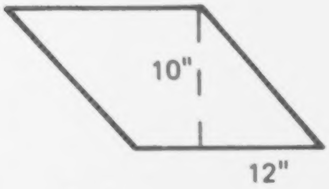
4. b = 12", h = 8 1/2"
5. b = 3.2', h = 5.8 '
6. b = 1.01 miles, h = .05 mile
7. b = .8", h = .2"
8. b = 1 1/7 yards, h = 5 1/3 yards
9. b = 9 1/2", h = 10 1/4"
10. b = 8', h = .3'

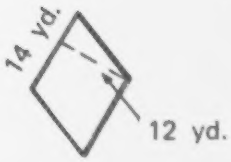
BASIC MATH AND MEASURING
UNIT V

ASSIGNMENT SHEET #25 — CALCULATE THE AREAS OF GIVEN RHOMBUSES

Directions: Calculate the area for each rhombus.

1. 

2. 

3. 

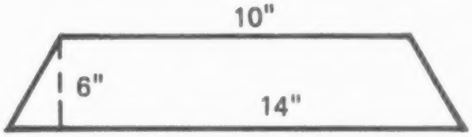
4. $b = 8'$, $h = 7'$
5. $b = 10\ 1/2''$, $h = 6\ 1/3''$
6. $b = 1.2$ yards, $h = .8$ yard
7. $b = 1/8'$, $h = 1/10'$
8. $b = 1.03''$, $h = .3''$
9. $b = 3.4'$, $h = 2.2'$
10. $b = 30\ 1/4$ miles, $h = 8\ 1/2$ miles

BASIC MATH AND MEASURING
UNIT V

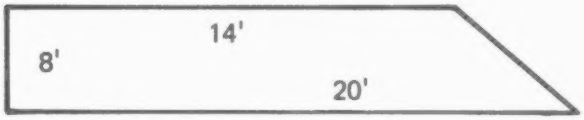
ASSIGNMENT SHEET #26 — CALCULATE THE AREAS OF GIVEN TRAPEZOIDS

Directions: Calculate the area for each trapezoid.

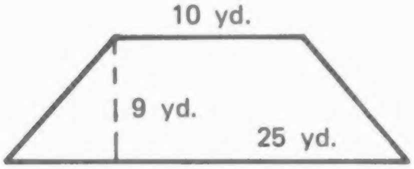
1.



2.



3.



4. $h = 4''$, $b_1 = 7''$, $b_2 = 2''$

5. $h = 8.2$ yards, $b_1 = 1.3$ yards, $b_2 = .5$ yards

6. $h = 3\frac{1}{2}'$, $b_1 = 3\frac{1}{4}'$, $b_2 = 2\frac{3}{4}'$

7. $h = 12$ miles, $b_1 = 5\frac{1}{2}$ miles, $b_2 = 7\frac{1}{2}$ miles

8. $h = 13''$, $b_1 = 6''$, $b_2 = 4''$

9. $h = .04'$, $b_1 = 1.7'$, $b_2 = 2.3'$

10. $h = 1.8''$, $b_1 = .5''$, $b_2 = 8.5''$

BASIC MATH AND MEASURING
UNIT V

ASSIGNMENT SHEET #27 — CALCULATE THE CIRCUMFERENCES OF GIVEN CIRCLES

1. Solve for the circumferences of the following circles. (Use $\pi = 3.14$)
   a. Diameter = 4 feet
   b. Diameter = 6 inches
   c. Radius = 2.5 inches
   d. Diameter = 8 yards
   e. Radius = 8 yards
   f. Radius = 9 inches
   g. Diameter = 12 feet
   h. Diameter = 14 feet
   i. Radius = 13.3 yards
   j. Radius = .0026 inch
   k. Diameter = 10 feet
   l. Radius = 10 feet

BASIC MATH AND MEASURING
UNIT V

ASSIGNMENT SHEET #28 — CALCULATE THE AREAS OF GIVEN CIRCLES

1. Solve for the areas of these circles. (Use $\pi = 3.14$)

	Measurement	Area
a.	Radius 6 inches	
b.	Diameter 10 feet	
c.	Diameter 14 feet	
d.	Radius 2.5 inches	
e.	Radius 8 feet	
f.	Diameter 11 inches	
g.	Diameter 7 feet	
h.	Radius 3 inches	
i.	Radius 10 inches	
j.	Diameter 13 feet	
k.	Radius 4 inches	
l.	Diameter 5 feet	

BASIC MATH AND MEASURING
UNIT V

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

1. $1\frac{1}{4}$
2. $2\frac{3}{32}$
3. $12\frac{1}{4}$
4. $\frac{1}{8}$
5. $\frac{13}{16}$
6. $1\frac{13}{16}$
7. $\frac{15}{32}$
8. $21\frac{1}{4}$
9. 2
10. $\frac{1}{2}$

Assignment Sheet #2

1. 17.5705
2. 8.86632
3. 25.7563
4. 8.722
5. 0.154
6. 8.875
7. 1.640496 or 1.6405
8. 81.749430 or 81.7494
9. .0024
10. 3.04833

Assignment Sheet #3

1. 1 ÷ 2 = 0.500
2. 5 ÷ 8 = 0.625
3. 1 ÷ 4 = 0.250
4. 1 ÷ 8 = 0.125
5. 5 ÷ 16 = 0.3125
6. 9 ÷ 16 = 0.5625
7. 3 ÷ 4 = 0.750
8. 7 ÷ 8 = 0.875
9. 3 ÷ 8 = 0.375
10. 11 ÷ 16 = 0.6875
11. $\frac{3}{8}$
12. $\frac{19}{32}$
13. $2\frac{23}{32}$
14. $\frac{7}{64}$
15. $1\frac{54}{64}$ or $1\frac{27}{32}$
16. $\frac{3}{4}$
17. $\frac{2}{3}$
18. $\frac{3}{4}$
19. $\frac{1}{3}$
20. $\frac{11}{32}$
21. $\frac{9}{16}$
22. $1\frac{1}{8}$
23. $\frac{5}{8}$
24. $1\frac{3}{16}$
25. $\frac{3}{4}$

Assignment Sheet #4

A.
1. .125
2. .25
3. .50
4. .75
5. .625
6. .35
7. .4375
8. .1111---
9. .444---
10. .80

B.
1. 25%
2. $22\frac{2}{9}$% or 22.22%
3. 70%
4. 75%
5. 100%
6. 81.81% or $81\frac{9}{11}$%
7. $33\frac{1}{3}$% or 33.33%
8. 44.44% or $44\frac{4}{9}$%
9. $33\frac{1}{3}$% or 33.33%
10. $62\frac{1}{2}$% or 62.5%

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #5

A. 1. 1/2
2. 1/4
3. 1/3
4. 9/25
5. 7/25
6. 1/7
7. 21/100
8. 9/20
9. 2/3
10. 7/10

B. 1. .47
2. .15
3. .333
4. .62
5. .75
6. .03
7. .168
8. .09
9. .10
10. .50

Assignment Sheet #6

A. 1. 1/2
2. 4/5
3. 7/10
4. 1/4
5. 17/25
6. 11/20
7. 47/50
8. 3/8
9. 7/8
10. 53/250

B. 1. 12%
2. 19%
3. 70%
4. 29%
5. 37%
6. 42%
7. 50%
8. 52.3%
9. 74.6%
10. 375%

Assignment Sheet #7

1. .0625
2. .875
3. .25
4. .5
5. .5625
6. 7/16
7. 5/16
8. 3/8
9. 1/8
10. 11/16
11. 9.56′ or 9.5625′
12. 3.38′ or 3.3853′
13. 14.19′ or 14.1866′
14. 1.5′
15. 2′ 6″
16. 8′ 7 3/5″
17. 11′ 8 9/10″
18. 17′ 1 3/10″

Assignment Sheet #8

1. 0.0396875 centimeters
2. 4.88 meters
3. 22.5 kilograms

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #9

1. a. 4
   b. no
   c. no
   d. 4
   e. approximate
   f. no
2. a. no
   b. 5 inches
   c. no
   d. approximate
   e. nearest unit

3. a. 1 inch
   b. 4 inches
   c. 3 inches
   d. approximate

4. a. no
   b. yes

5. a. 2
   b. 2 1/2 inches

6. 1/2, 2 1/2, 3 1/2, 4 1/2

7. a. 2 1/2
   b. 2 1/2 inches

8. a. 4 inches
   b. 4 inches
   c. 1 inch
   d. no

9. a. 3 1/2 inches
   b. 5 inches
   c. 1 1/2 inches

10. a. 1/4
    b. 4

11. 1 1/2, 2 1/4, 2 3/4, 3 1/4, 3 1/2, 4, 4 3/4

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #10

1. a. 5 3/4
   b. 1/2
   c. 1 1/2
   d. 7 1/4
   e. 3 1/4

2. a. 2 1/2
   b. 1 3/4
   c. 3
   d. 7 7/8
   e. 3 3/16 (already in simplest form)

3. a. 3/4 inch
   b. 1 1/4 inches
   c. 2 inches
   d. 2 1/2 inches
   e. 3 1/4 inches
   f. 4 3/4 inches

4. a. 4 inches
   b. 1/2 inch
   c. 4 3/4 inches
   d. 2 1/4 inches

5. E

6. a. 8
   b. 2
   c. 16
   d. 4
   e. half
   f. fourth
   g. 2
   h. 4

7. a. 8
   b. eighths
   c. 8

8. a. 4 7/8
   b. 1/8
   c. 3
   d. 1 1/8
   e. 2 3/8

9. 1/8, 4/8, 5/8, 8/8

ANSWERS TO ASSIGNMENT SHEETS

10. a. 3 2/4 = 3 4/8
    b. 2 2/8
    c. 3 6/8

11. a. 2 2/4 or 2 1/2
    b. 2 2/4 or 2 1/2

Assignment Sheet #11

1. a. 1/8 inch
   b. 1/2 inch
   c. 3/4 inch
   d. 1 1/4 inches
   e. 1 5/8 inches
   f. 1 7/8 inches
   g. 2 3/8 inches
   h. 3 inches
   i. 3 1/2 inches
   j. 3 3/4 inches
   k. 4 1/8 inches
   l. 4 5/8 inches
   m. 5 1/4 inches
   n. 5 5/8 inches

2. a. 1 1/8 inches
   b. 3/8 inch
   c. 5/8 inch
   d. 1/4 inch
   e. 2 1/2 inches
   f. 3 inches
   g. 1 1/8 inches
   h. 1/4 inch
   i. 1/2 inch
   j. 2 1/4 inch

Assignment Sheet #12

1. a. 16
   b. 1/16
   c. 16
   d. 1/16 inch
   e. 3 1/16 inch

2. a. 2
   b. 8
   c. 1
   d. 4
   e. 16

3. a. 16
   b. Sixteenth
   c. 16
   d. 8

4. a. Yes
   b. No
   c. Yes
   d. Yes
   e. No

f. Yes
g. No

5. a. 1/16, 5/16, 7/16, 9/16, 11/16, 15/16
b. 3 4/8, 3 2/4, 3 1/2

6. a. 1/8
b. 3/4 and 6/8
c. 2/2, 4/4, 8/8, 16/16
d. 3/8
e. 5/8
f. 3/4
g. Zero
h. Yes

7. a. 16ths
b. 5/16
c. 5/16
d. 3 5/16 inches
e. 4 5/16 inches

8. a. 1 9/16 inches
b. 2 7/8 inches
c. 3 1/2 inches
d. 4 3/16 inches

9. a. 2 inches
b. 2 inches
c. 1 3/4 inches
d. 1 7/8 inches
e. 1 13/16 inches
f. E

10. a. 15/16
b. 1 1/2
c. 2 3/16
d. 3 1/4
e. 4 3/8
f. 5

11. a. 0 inches
b. 1/4 inch
c. 7/16 inch
d. 1/2 inch
e. 9/16 inch
f. 7/8 inch
g. 1 inch

ANSWERS TO ASSIGNMENT SHEETS

12. a. C
    b. E
    c. D
    d. B
    e. A

Assignment Sheet #13 (Instructor should check originals in Assignment Sheet)

1. 2 $^{1}/_{4}$ inches
2. 4 $^{13}/_{16}$ inches
3. 5 $^{1}/_{8}$ inches
4. 3 $^{1}/_{2}$ inches
5. $^{1}/_{2}$ inch
6. 1 $^{9}/_{16}$ inches
7. 4 $^{5}/_{8}$ inches
8. 2 inches
9. 5 $^{7}/_{8}$ inches
10. 3 inches
11. 1 $^{15}/_{16}$ inches
12. 4 $^{3}/_{4}$ inches

Assignment Sheet #14 (Instructor should check originals in Assignment Sheet)

1. a. 2 $^{15}/_{16}$ inches
   b. 1 $^{3}/_{16}$ inches
   c. 1 inch
   d. 2 $^{3}/_{16}$ inches
   e. 2 $^{13}/_{16}$ inches

2. a. $^{7}/_{16}$ inch
   b. 2 $^{3}/_{16}$ inches
   c. 2 $^{3}/_{16}$ inches
   d. 1 $^{15}/_{16}$ inches
   e. 2 inches
   f. $^{1}/_{2}$ inch
   g. 2 $^{7}/_{16}$ inches
   h. 2 $^{7}/_{16}$ inches
   i. 1 $^{5}/_{16}$ inches
   j. $^{7}/_{16}$ inch

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #15 (Instructor should check originals in Assignment Sheet)

1. a. 3 3/4 inches
    b. 1/2 inch
    c. 2 1/2 inches
    d. 1) 1 9/16 inches
        2) 3/8 inch
    e. 1) 3 inches
        2) 3 inches
    f. 1) 4 5/16 inches
        2) 1 3/16 inches
    g. 1) 1 7/16 inches
        2) 2 inches
        3) 2 7/16 inches
    h. 1) 1 3/4 inches
        2) 2 3/8 inches
        3) 3 9/16 inches
    i. 1) 5/8 inches
        2) 5/16 inches
        3) 5/8 inches
    j. 1) 1 5/16 inches
        2) 1 7/16 inches
        3) 11/16 inch
        4) 1 1/4 inches
        5) 1 3/4 inches
        6) 5/8 inch

Assignment Sheet #16 — Evaluated to the satisfaction of the instructor

Assignment Sheet #17

1. a. 4 5/8 inches
    b. 2 5/16 inches
    c. 2 5/16 inches
    d. Teacher evaluation

2. a. 4 3/4 inches
    b. 2 3/8 inches
    c. Teacher evaluation

3. a. 5 7/8 inches
    b. 2 15/16 inches
    c. Teacher evaluation
    d. 2 1/8 inches
    e. 1 1/16 inches
    f. Teacher evaluation
    g. Teacher evaluation

4. Evaluated to the satisfaction of the instructor

5. Evaluated to the satisfaction of the instructor

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #18

1. 24'
2. 28'
3. 24'
4. 40"
5. 14"
6. 18'
7. 46"
8. 9"
9. 28 1/2"
10. 18 1/2"
11. 3 miles
12. 22 yards
13. 17"
14. 48'
15. 38'

Assignment Sheet #19

1. 16'
2. 8'
3. 12"
4. 24"
5. 2'
6. 20"
7. 32"
8. 28"
9. 42"
10. 28.8"
11. 3"
12. 8"
13. 42"
14. 1"
15. 2"

Assignment Sheet #20

1. 21"
2. 53'
3. 15"
4. 65"
5. 48'
6. 10 1/2"
7. 13 3/4'
8. 16 1/4'
9. 34'
10. 46'
11. 13 1/4"
12. 23.7'
13. 18"
14. .9'
15. 17 3/20'

Assignment Sheet #21

1. 128 square inches
2. 6 square feet
3. 35 square yards
4. 24 square miles
5. 7.14 square feet
6. 20 square inches
7. 1272 square feet
8. 12 2/5 square inches
9. 158 square feet
10. 13.53 square yards

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #22

1. 80 square feet
2. 192 square inches
3. 300 square yards
4. 20 square inches
5. 87 $^{1}/_{8}$ square feet
6. 38.64 square yards
7. 86 $^{5}/_{8}$ square inches
8. 46.475 $^{2}/_{5}$ square miles
9. 14.725 square feet
10. 97.6 square inches

Assignment Sheet #23

1. 64 square inches
2. 225 square feet
3. 529 square yards
4. 110 $^{1}/_{4}$ square miles
5. 40 $^{1}/_{9}$ square feet
6. 75.69 square yards
7. 2.0164 square inches
8. 93 $^{4}/_{9}$ square inches
9. 219.04 square feet
10. $^{1}/_{64}$ square mile

Assignment Sheet #24

1. 14 square feet
2. 3 square inches
3. 48 square feet
4. 51 square inches
5. 9.28 square feet
6. .02525 square mile
7. .08 square inch
8. 3 $^{1}/_{21}$ square yards
9. 48 $^{11}/_{16}$ square inches
10. 1.2 square foot

Assignment Sheet #25

1. 24 square feet
2. 120 square inches
3. 168 square yards
4. 56 square feet
5. 66 $^{1}/_{2}$ square inches
6. .96 square yard
7. $^{1}/_{80}$ square foot
8. .309 square inch
9. 7.48 square feet
10. 257 $^{1}/_{8}$ square miles

Assignment Sheet #26

1. 72 square inches
2. 136 square feet
3. 157 $^{1}/_{2}$ square yards
4. 18 square inches
5. 7.38 square yards
6. 10 $^{1}/_{2}$ square feet
7. 78 square miles
8. 65 square inches
9. .08 square feet
10. 8.1 square inches

Assignment Sheet #27

1.
    - a. 12.56 feet
    - b. 18.84 feet
    - c. 15.70 inches
    - d. 25.12 yards
    - e. 50.24 yards
    - f. 56.52 inches
    - g. 37.68 feet
    - h. 43.96 feet
    - i. 83.524 yards
    - j. .016328 inch
    - k. 31.40 feet
    - l. 62.80 feet

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #28

1. a. 113.04 square inches
   b. 78.50 square feet
   c. 153.86 square feet
   d. 19.625 square inches
   e. 200.96 square feet
   f. 94.985 square inches
   g. 38.465 square feet
   h. 28.26 square inches
   i. 314 square inches
   j. 132.665 square feet
   k. 50.24 square inches
   l. 19.625 square feet

BASIC MATH AND MEASURING
UNIT V

JOB SHEET #1 — ADJUST A BEVEL SQUARE TO A 45° ANGLE USING A FRAMING SQUARE, A COMBINATION SQUARE, AND A PROTRACTOR

I. Tools and materials

A. Bevel square

B. Framing square

C. Combination square

D. Protractor

II. Procedure

(NOTE: The illustrations and procedures in this job sheet are adapted from materials originally published by the Research and Curriculum Unit for Vocational-Technical Education, College of Education, Mississippi State University, Mississippi State, Mississippi, and are reprinted with permission.)

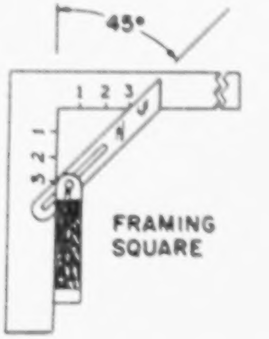
A. Place the framing square on a clean work area

B. Loosen the locking screw on the bevel square so that the blade moves with a slight friction

C. Place the handle along the inside of the blade of the framing square so that it is straight against the framing square

D. Adjust the blade on the bevel square so that it is at a graduation on the tongue of the framing square equal to the graduation scale at the handle of the bevel square (Figure 1)

FIGURE 1



E. Hold the bevel square with one hand and tighten the locking screw with the other hand

JOB SHEET #1

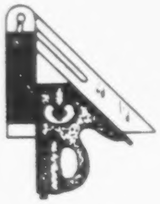
F. Have your instructor check for an exact 45° angle on your bevel square

G. Loosen the thumb screw on a combination square and slide the handle off the scale

H. Loosen the locking screw on the bevel square so that the blade moves with a slight friction

I. Place the handle of the combination square on a clean work area, hold it in place with one hand, adjust the blade on the bevel square so that it fits firmly over the 45° angle on the combination square, then tighten the bevel square locking screw (Figure 2)

FIGURE 2



J. Have your instructor check for an exact 45° angle on your bevel square

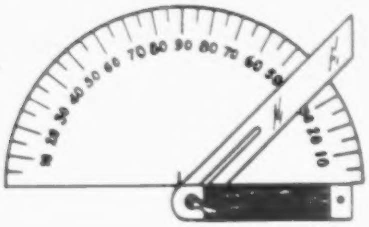
K. Place a protractor on a clean work area

L. Loosen the locking screw on the bevel square so that the blade moves with a slight friction

JOB SHEET #1

M. Place the handle of the bevel square at the bottom edge of the protractor, hold it with one hand so that it is straight, exactly over the 45° angle on the protractor, then tighten the locking screw (Figure 3)

FIGURE 3



N. Have your instructor check for an exact 45° angle on your bevel square

O. Return tools to proper storage area

BASIC MATH AND MEASURING
UNIT V

JOB SHEET #2 — USE A COMBINATION SQUARE TO FORM 90° AND 45° ANGLES AND TO DRAW PARALLEL LINES ON SELECTED METAL STOCK

I. Tools and materials

A. Combination square

B. Soapstone (sharpened)

C. Flat metal stock as selected by instructor

D. Framing square

II. Procedure

(NOTE: The illustrations and procedures in this job sheet are adapted from materials originally published by the Research and Curriculum Unit for Vocational-Technical Education, College of Education, Mississippi State University, Mississippi State, Mississippi, and are reprinted with permission.)

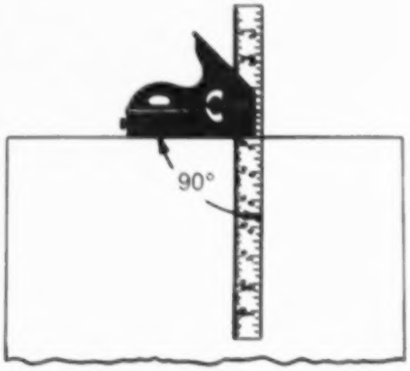
A. Place flat metal stock on a clean working area

B. Butt the flat part of the handle along the upper edge of the metal stock so the scale forms a 90° angle down the surface of the metal

C. Loosen the thumb screw on the bevel and move the scale down the metal to a point where it indicates exactly 6", then tighten the thumb screw

D. Mark the 6", 90° angle with soapstone (Figure 1)

FIGURE 1



E. Have your instructor check for an exact 90° angle and a distance of exactly 6"

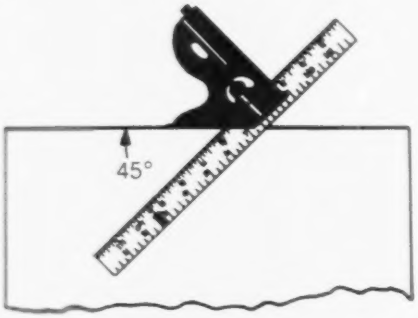
JOB SHEET #2

F. Butt the flat part of the handle along the upper edge of the metal stock so the scale forms a 45° angle down and across the surface of the metal

G. Loosen the thumb screw on the bevel and move the scale down the metal to a point where it indicates exactly 6", then tighten the thumb screw

H. Mark the 6", 45° angle with soapstone (Figure 2)

FIGURE 2



I. Have your instructor check for an exact 45° angle and a distance of exactly 6"

J. Loosen the thumb screw and slide the scale out the 90° side of the handle to prepare for marking parallel lines on the metal

K. Place the scale on the 2" mark and tighten the thumb screw

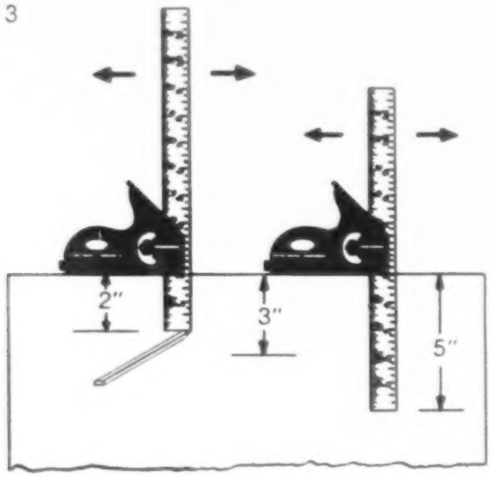
L. Mark the 2" distance in two places along the left and right side of the metal

M. Reset the scale at the 3" mark and mark the 3" distance at two places along the left and right side of the metal

JOB SHEET #2

N. Reset the scale at the 5″ mark and mark the 5″ distance at two places along the left and right side of the metal (Figure 3)

FIGURE 3



O. Remove the combination square

P. Line up the framing square along both 2″ marks and draw a straight line across the metal with soapstone

Q. Line up the framing square along both 3″ marks and draw a straight line across the metal with soapstone

R. Line up the framing square along both 5″ marks and draw a straight line across the metal with soapstone

S. Have your instructor check your work for parallel lines across the metal at points exactly 2″, 3″, and 5″ from the top

T. Clean up the area and return tools and materials to proper storage areas

BASIC MATH AND MEASURING
UNIT V

NAME ____________________

TEST

1. Match the terms on the right with their correct definitions.

_____a. Area, the measure of the surface inside a figure

_____b. Base

_____c. Height

_____d. Length

_____e. Perimeter, the distance around the edge of a flat surface

_____f. Side or length of a side

_____g. Thickness

_____h. Width

_____i. Circumference, the distance around a circle

_____j. Diameter, the distance across the center of a circle

_____k. Radius, half the distance of the diameter of a circle

_____l. Subdivisions on a rule that are equal in length

_____m. A system of measuring area

_____n. A system of measuring volume

_____o. Numbers which appear below a line to clarify a reference such as base one, b_1, or base two, b_2

1. R or r
2. T or t
3. Cubic measure
4. B or b
5. D or d
6. Sublinear numbers
7. L or l
8. A or a
9. Pi (π)
10. H or h
11. Graduations
12. Square measure
13. P or p
14. S or s
15. Superlinear numbers

TEST

______p. Numbers which appear above a line to usually indicate the square of a number or letter designation or an increase in power such as R^2 or r^2 indicates that a radius should be multiplied times itself

______q. A letter from the Greek alphabet used to identify 3.1416 or 3.14, and used to establish the ratio of the circumference of a circle to its diameter

16. W or w
17. C or c

2. Match basic mathematical terms with their definitions.

______a. Any number or numbers used to indicate an entire unit, quantity, or amount

______b. Two numbers consisting of a numerator and denominator separated by a fraction line to indicate a part of one unit

______c. Any whole number plus a fractional part of one additional unit

______d. The top number of a fraction

______e. The base or lower number of a fraction

______f. A fraction whose numerator is less than the denominator, indicating a value of less than one unit

______g. A fraction whose numerator is equal to or greater than the denominator, indicating a value greater than one unit

______h. A proper fraction with a numerator of 1

______i. A fraction with either or both terms expressed as a fraction or mixed number

______j. The lowest base number by which a fraction may be reduced for simplification in unit measurement

______k. Two fractions with the same denominator in each fraction which allows for simplification in adding and dividing fractions

1. Improper fraction
2. Numerator
3. Factors
4. Unit fraction
5. Whole number
6. Lowest terms
7. Mixed number
8. Denominator
9. Fraction
10. Proper fraction
11. Complex fraction

TEST

______l.	The parts of a number that can be multiplied to equal that number	12. Common denominator
______m.	The result of addition	13. Quotient
______n.	The result of division	14. Sum

3. Select true statements concerning advantages of decimal equivalent and conversion charts by placing an "X" in the appropriate blanks.

______a. Convenience of converting units

1) Fractions to decimals

2) Decimals to fractions

3) Feet and inches to decimals and vice versa

______b. Saves time

______c. Establishes standard for unit conversion

______d. Lists sizes from smallest to largest

______e. Difficult to read, but still faster

4. Complete statements concerning the uses for fractions by circling the word(s) that best complete each statement.

a. Combines parts of a unit or units into (a total amount) (subdivisions)

b. Allows a system for adding, subtracting, multiplying, or dividing (parts of a unit) (odd numbers)

5. Select true statements concerning uses for decimals by placing an "X" in the appropriate blanks.

a. Allows for a lesser method of accuracy than fractional form

b. Provides a conversion system for measuring materials

6. Complete definitions of methods of expressing fractions and decimal equivalents by circling the word(s) that best completes each statement.

a. Word — (Always) (May be) in writing or (always) (may be) spoken

b. Number — (Sometimes) (Always) in writing; a system of numerators, denominators, whole numbers, mixed numbers, and other forms to signify a value

TEST

7. Select true statements concerning percent and its uses by placing an "X" in the appropriate blanks.

   _____a. Percent is based upon thousands and is used to express the ratio of an amount related to one hundred

   _____b. 100% means the total amount of items or amounts in question

8. Complete lists of units of measure found on rules by circling the word that best defines each list.

   a. (Decimal) (Fractional)

      1) Eighths

      2) Sixteenths

      3) Thirty-seconds

      4) Sixty-fourths

   b. (Decimal) (Fractional)

      1) Tenths

      2) Hundredths

      3) Thousands

   c. (Metric) (Decimal)

      1) Meter

      2) Decimeter

      3) Centimeter

      4) Millimeter

9. Arrange in order the steps for reading a rule by placing the correct sequence number in the appropriate blank.

   _____a. Total the number of graduations

   _____b. Reduce graduations to lowest terms

   _____c. Select proper scale

   _____d. Count whole units

TEST

10. Arrange in order the steps for finding mid-point of a given distance by placing the correct sequence number in the appropriate blank.

______a. Measure the total distance

______b. Divide the distance by two or multiply it by one-half

______c. Reduce graduation to lowest terms

11. Complete the following formulas for perimeters.

a. Rectangle — P = ______________

b. Square — P = ______________

c. Triangle — P = ______________

12. Calculate the perimeters for the following rectangles, squares, and triangles.

a. Rectangles:

1) length = 4′, width = 3′______________

2) length = 5″, width = 7″ ______________

3) length = 6′, width = 5′______________

b. Squares:

1) length of side = 4′ ______________

2) length of side = 7″ ______________

3) length of side = 3′ ______________

c. Triangles (length of side one, two, and three in order):

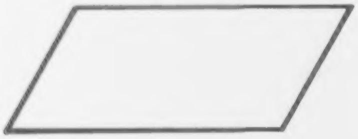
1) 3′, 3′, 3′______________

2) 3′, 5′, 7′______________

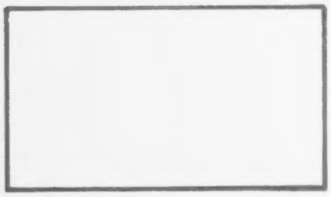
3) 2′, 3′, 12″______________

TEST

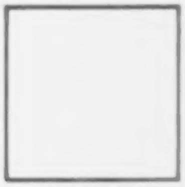
13. Identify basic geometric figures by writing the correct name below each of the following illustrations.



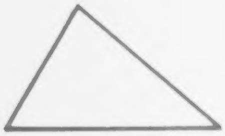
a. ____________________



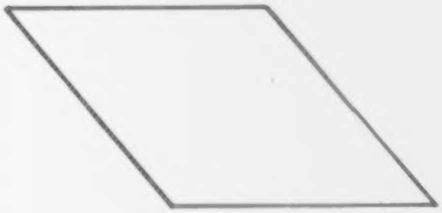
b. ____________________



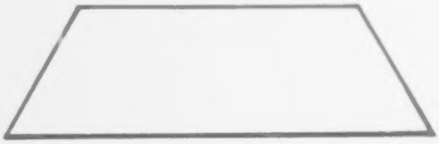
c. ____________________



d. ____________________



e. ____________________



f. ____________________

14. Calculate areas of the following geometric figures.

    a. A parallelogram with a base of 10 inches and a height of 4 inches

    ____

    b. A rectangle with a length of 6 yards and a width of 3 yards

    ____

    c. A square with a side of 5 feet

    ____

TEST

d. A triangle with a base of 4 feet and a height of 3 feet

e. A rhombus with a base of 9 feet and a height of 6 feet

f. A trapezoid with a height of 6 inches, one base of 4 inches, and another base of 3 inches

15. Calculate the measurements of the following circles.

a. What is the diameter of a circle with a [illegible] radius?

b. What is the radius of a circle with a 9′ diameter?

c. What is the circumference of a circle with a 6′ diameter?

d. What is the area of a circle with a radius of 4″?

16. Solve the following problems concerning methods of sizing commonly used steel stock.

a. A square bar 10′ long and 8″ wide would need what other measurement to be properly sized?

b. A flat bar 10′ long and 1/2″ thick would need what other measurement to be properly sized?

TEST

c. If the width of the beam on a 5′ H beam is 4″, what other measurement would be needed to properly size the beam?

d. What kind of stock is sized according to length and diameter?

17. Demonstrate the ability to:

    a. Add, subtract, multiply, and divide fractions.
    b. Add, subtract, multiply, and divide decimal equivalents.
    c. Convert fractions to decimal form.
    d. Write fractions as decimals and percents.
    e. Write percents as fractions and decimals.
    f. Write decimals as fractions and percents.
    g. Make conversions with the decimal equivalent and inches to decimal conversion charts.
    h. Use the English-Metric Conversion Chart.
    i. Measure distance with 1″, 1/2″, and 1/4″ graduations.
    j. Measure distances with 1/4″ and 1/8″ graduations.
    k. Measure distances with 1/8″ graduations.
    l. Measure distances with 1/16″ graduations.
    m. Measure given line segments with 1/16″ graduations.
    n. Measure dimensions of given objects with a rule.
    o. Measure given lines and objects with a rule.
    p. Use a rule to draw lines and objects to given specifications.
    q. Find the mid-point of given lines and figures.
    r. Calculate the perimeters of given rectangles.

TEST

s. Calculate the perimeters of given squares.

t. Calculate the perimeters of given triangles.

u. Calculate the areas of given parallelograms.

v. Calculate the areas of given rectangles.

w. Calculate the areas of given squares.

x. Calculate the areas of given triangles.

y. Calculate the areas of given rhombuses.

z. Calculate the areas of given trapezoids.

aa. Calculate the circumferences of given circles.

bb. Calculate the areas of given circles.

cc. Adjust a bevel square to a 45° angle using a framing square, a combination square, and a protractor.

dd. Use a combination square to form 90° and 45° angles and to draw parallel lines on selected metal stock.

(NOTE: If these activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

BASIC MATH AND MEASURING
UNIT V

ANSWERS TO TEST

1. a. 8
   b. 4
   c. 10
   d. 7
   e. 13
   f. 14
   g. 2
   h. 16
   i. 17
   j. 5
   k. 1
   l. 11
   m. 12
   n. 3
   o. 6
   p. 15
   q. 9

2. a. 5
   b. 9
   c. 7
   d. 2
   e. 8
   f. 10
   g. 1
   h. 4
   i. 11
   j. 6
   k. 12
   l. 3
   m. 14
   n. 13

3. a, b, c, d

4. a. Total amount
   b. Parts of a unit

5. b

6. a. May be, may be
   b. Always

7. b

8. a. Fractional
   b. Decimal
   c. Metric

9. a. 3
   b. 4
   c. 1
   d. 2

10. a. 1
    b. 2
    c. 3

11. a. 2L + 2W
    b. 4s
    c. $S_1 + S_2 = S_3$

ANSWERS TO TEST

12. a. 1) 14′
    2) 24″
    3) 22′
  b. 1) 16′
    2) 28″
    3) 12′
  c. 1) 9′
    2) 15′
    3) 6′

13. a. Parallelogram
  b. Rectangle
  c. Square
  d. Triangle
  e. Rhombus
  f. Trapezoid

14. a. 40 square inches
  b. 18 square yards
  c. 25 square feet
  d. 6 square feet
  e. 54 square feet
  f. 21 square inches

15. a. 6′
  b. 4 ½′
  c. 18.84′
  d. 50.24″

16. a. Thickness
  b. Width
  c. The height of the beam
  d. Hot and cold-rolled rounds

17. Evaluated to the satisfaction of the instructor

APPLYING FOR A WELDING JOB

UNIT VI

UNIT OBJECTIVE

After completion of this unit, the student should be able to discuss procedures in applying for a welding job, list reasons why welding job applicants need to be well prepared, and what employers look for in a welding job applicant. The student should also be able to complete a social security card application, a personal resume, write a letter requesting a job interview, and fill out a job application form and a medical questionnaire. This knowledge will be evidenced by correctly performing the procedures outlined in the assignment sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to applying for a welding job with their correct definitions.
2. Complete a list of reasons why a worker needs a social security card.
3. Complete a list of information required on a social security card application.
4. Select true statements concerning guidelines for filling out a social security application.
5. Complete a list of reasons why beginning welders do get jobs.
6. List ways to find a job.
7. Complete statements concerning what employers look for in welding job applicants.
8. Select true statements concerning why welding job applicants need to be well prepared.
9. Complete a list of guidelines for preparing an effective resume.
10. Complete statements concerning effective ways to arrange for a job interview.
11. Select true statements concerning guidelines for filling out a job application.

OBJECTIVE SHEET

12. Select true statements concerning guidelines for making a good impression at a welding job interview.

13. Complete statements concerning guidelines for succeeding with a welding test.

14. Complete statements concerning guidelines for completing a medical questionnaire.

15. Use assignment sheets to:

    a. Complete a social security card application.

    b. Prepare a personal resume.

    c. Write a letter requesting a job interview.

    d. Complete an application for employment as a welder.

    e. Complete a medical questionnaire.

APPLYING FOR A WELDING JOB
UNIT VI

SUGGESTED ACTIVITIES

I. Provide student with objective sheet.

II. Provide student with information and assignment sheets.

III. Make transparency.

IV. Discuss unit and specific objectives.

V. Discuss information and assignment sheets.

VI. Invite a personnel director from a company that hires welders to talk to the class about job interviews and the value of a resume in a job application.

VII. Invite a supervisor who administers welding tests to job applicants to talk to the class about test procedures and how applicants should prepare for them.

VIII. Invite a local or area welding supervisor in charge of welding training in industry to talk to the class about the welding skills that industry is looking for.

IX. Have students role-play job interviews.

X. Have an experienced welder talk to the class about how he or she learned to weld, their first welding job, the types of welding jobs they've had through the years, and the manner in which they applied for jobs.

XI. Invite a former student to talk to the class abut the transition from training to actual employment, and have the student highlight elements of training that have proved most beneficial on the job.

XII. Much of the information requested of students in the assignment sheets is private and confidential and should be returned to individual students after assignment sheets are evaluated.

XIII. Time the teaching of this unit of instruction to the best advantage of those students who will soon be looking for welding jobs, and have counselors or placement personnel read the unit so they'll be aware of the special requirements for getting a welding job.

XIV. Give test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

  A. Objective sheet

  B. Information sheet

  C. Transparency 1 — Welding Test Procedure

  D. Assignment sheets

    1. Assignment Sheet #1 — Complete a Social Security Card Application

    2. Assignment Sheet #2 — Prepare a Personal Resume

    3. Assignment Sheet #3 — Write a Letter Requesting a Job Interview

    4. Assignment Sheet #4 — Complete an Application for Employment as a Welder

    5. Assignment Sheet #5 — Complete a Medical Questionnaire

  E. Test

  F. Answers to test

II. References:

  A. *VICA, Secondary Edition, Spring 1983.* Leesburg, VA 22075: Vocational Instructional Clubs of America, Inc., 1983.

  (NOTE: This secondary edition of the official journal of VICA includes several articles designed to assist vocational students find jobs. The articles include, "The Job Hunt: Time to Start," "Get Your Bearings: Where to Begin," "Set Your Sights: Where to Look," "Hit the Trail: How to Apply," and "Tell Your Story: The Interview.")

  B. *VICA, Professional Edition, Spring 1983.* Leesburg, VA 22075: Vocational Industrial Clubs of America, Inc., 1983.

  (NOTE: This professional edition of the official journal of VICA includes the article, "Helping Your Students With Their Job Search," and a sample application for employment.)

APPLYING FOR A WELDING JOB
UNIT VI

INFORMATION SHEET

I. Terms and definitions

A. Awards — Recognition received for outstanding achievement

Example: Winning or placing in a skills contest

B. Fraternal activities — Clubs or organizations that a person belongs to and participates in

Example: Membership in Vocational Industrial Clubs of America (VICA), membership in a local chapter of the American Welding Society (AWS), athletic teams, and any groups dedicated to community service

C. Extra-curricular activities — Hobbies and pastimes

Example: Model building, hunting, fishing, and camping

D. Qualifications — The experience, education, and physical abilities which suit a person for a given job

Example: Acceptable grades in school, summer jobs, and good eye-hand coordination

E. Vocational preparation — Vocational courses taken and skills acquired there, or skills acquired in on-the-job situations

Example: Shop, welding, carpentry, auto mechanics, and after-school or summer jobs directly related to job objectives

F. Resumé — A brief typed summary of one's qualifications and experience that is used in applying for a job

Example: See Assignment Sheet #2.

II. Reasons why a worker needs a social security card

A. Almost all U.S. companies require workers to have or obtain a social security card or have available their social security card number

B. Through the social security program, earnings and employee and employer contributions are recorded so that workers will receive retirement or disability benefits

INFORMATION SHEET

C. In the event of a worker's death, social security records are used to determine benefits for survivors

D. Information from social security records helps the government conduct research programs for income distribution and other areas such as health insurance

III. Information required on a social security card application (Assignment Sheet #1)

A. Your name as you use it now

B. The name given you at birth

C. Your place of birth

D. Your citizenship or alien status

E. Your date of birth

F. Your sex

G. Your mother's name at her birth

H. Your father's name

I. Your mailing address

J. Your phone number

IV. Guidelines for filling out a social security application (Assignment Sheet #1)

A. If you do not know the answer to a question, write "unknown" in the space so it will indicate you did not overlook the question

B. Use abbreviations only when you know they will be completely understood

C. Include the area code when listing your telephone number

D. Sign your name as you usually write it, but do not print your name unless you usually print your signature

E. Include brief notes to clarify any information that could be misunderstood

Example: Should your father's last name be different from your name at birth, write "step-father" or "adopting father" beside your father's name

INFORMATION SHEET

F. Complete your application only on Form SS-5 obtained from a social security office because the special paper is designed for machines that process information and xerox copies are difficult to process

(NOTE: The social security card application in Assignment Sheet #1 is designed for practice only, but you can take the completed practice copy with you to save time when you actually go to a social security office to obtain a social security card.)

G. Use the social security application form when applying for a replacement social security card

V. Reasons why beginning welders do get jobs

A. Experienced welders retire or sometimes go into business for themselves and those jobs have to be filled

B. Many jobs for welding machine operators require minimum training time, and beginners with good basic skills frequently stand as good a chance at these jobs as do experienced welders

C. Many companies prefer to train welders in their own way of doing things, and some of these companies would rather have new talent than have to retrain an experienced welder who might not be receptive to new materials or processes

D. Beginning welders are often given basic welding jobs that experienced welders don't care to work on, and start at pay scales that experienced welders might consider too low

(NOTE: Beginning pay scale should not be the most important element in evaluating a job opportunity because if you have the proper skills and attitudes, you will advance in both position and pay.)

VI. Ways to find a job

A. Classified ads in local and area newspapers

B. Private employment agencies

(NOTE: Private employment agencies charge a fee for their services.)

C. State employment offices

(NOTE: State employment offices charge no fees, and many employers list job openings with these state agencies for both full and part time work.)

D. Local labor union business office

INFORMATION SHEET

E. School instructors and counselors

(NOTE: Many schools have placement offices to help students find work or to help them prepare resumes and other information required for job applications.)

F. Working welders

(NOTE: Welders on the job sometimes know of openings that are not formally advertised, and they are good sources of information about job requirements, pay, and working conditions.)

G. Welding supply firms

VII. What employers look for in welding job applicants

A. Someone who is neat and clean

(NOTE: This does not mean you should wear a suit and tie to a welding job interview, in fact, you should not wear a suit and tie, but you should be clean and neatly dressed.)

B. Someone who has a good attendance record with previous employers or at school

C. Someone who has an accident-free work record with previous employers

D. Someone who has taken minimum time off in previous employment because of physical or personal problems

VIII. Why welding job applicants need to be well prepared

A. Applicants for a welding job not only have to complete a job application form and go through an interview, they frequently have to take a welding test

(NOTE: Many job applicants fill out a job application, have an interview, and then are hired or not hired on the basis of positive responses from references and previous employers, but welding is a field where you can or can't do it, and the welding test is an important part of the job-getting process.)

B. Many companies that hire welders also require that an applicant fill out a medical questionnaire and take a physical which includes a back x-ray

INFORMATION SHEET

IX. Guidelines for preparing an effective resume (Assignment Sheet #2)

  A. Arrange information in a logical order

  B. Use an outline form that is brief and to the point

  C. Type the resume or have it typed

  D. Check for proper grammar and spelling

  E. List education, work experience, and extra-curricular activities

  F. Limit the resume to one page if possible

X. Effective ways to arrange for a job interview

  A. Telephone:

    1. Indicate your interest in the company and the job

    2. State your name clearly

    3. Review your qualifications briefly

    4. Indicate that you will be available for the interview at a time most convenient for the company

    5. Have pencil and paper handy to write down any special instructions or the time set for the interview

    6. Double check information by repeating it to the person with whom you are talking, and thank them for the help before hanging up

  B. Letter: (Assignment Sheet #3)

    1. Open the letter with a brief reference to the ad or reference source that inspired you to want the interview

    2. State your qualifications briefly

    3. Indicate a telephone number, including area code, where you can be reached during the day, and a mailing address

    4. If you send a resume with your letter, indicate that it is enclosed

    5. Use a formal closing, and sign your name or type your name and sign above it

INFORMATION SHEET

6. Indicate the enclosure below your name

7. Use a typed, standard letter form, and have someone qualified check the letter for spelling, grammar, and overall neatness

C. Personal reference

(NOTE: Personal reference is one of the most effective ways to get a job, and when someone extends that courtesy, don't let them down by failing to follow up the reference or by being poorly prepared for the job interview.)

XI. Guidelines for filling out a job application (Assignment Sheet #4)

A. Read through the form before you start filling it out so you won't duplicate information or have to erase items

B. If the application specifies that certain items are to be printed, be sure to print, not write

C. Include the area code with your telephone number

D. Clarify any information that may be confusing with a brief note

E. Take your social security card with you to make sure you know the exact number

F. Know your height and weight

G. Prepare a list of previous employers' addresses and telephone numbers in advance

H. When listing references, do not use personal friends, but do include former teachers, your minister, your doctor or banker, or business persons

I. List all experience directly related to the job for which you are applying, even if it was only a short-term after-school or summer job

J. Be honest with all your answers, but keep your answers as positive as possible

Example: If you have left a temporary job for that reason only, indicate that it was only temporary employment, and if you have been dismissed from a job, indicate the true problem such as, "Enjoyed work, but had personality conflict with supervisor."

K. Ask questions when you have any doubt about how a question should be answered

INFORMATION SHEET

L. Be honest when stating your physical condition and include information which might limit conditions under which you can work or certain types of work you can not accomplish

Example: Persons with bad backs cannot do heavy lifting and persons with certain allergies require clean working environments

XII. Gudelines for making a good impression at a welding job interview

A. Be neat, clean, and properly dressed, and ON TIME

(NOTE: Sandals, thongs, cut-offs, and the like do not make good impressions at a job interview, but being properly dressed for the prospects that you will take a welding test can be impressive.)

B. Do not smoke or chew gum

C. Be positive with your answers, but do not try to oversell your abilities because the welding test you take later will say more about your abilities than words can

D. If friends or relatives accompany you, leave them in the car; do not take them with you to the interview

E. Concentrate on the skills you have that are directly related to the job you are applying for, but mention any basic skills you have with other welding processes, and especially skills you may have in blueprint reading and layout

F. Admit that you are nervous, if you are, but sit erect, keep eye contact with the interviewer, and use the best English you are capable of using

G. Let the interviewer know that you have brought your own tools along in the event you should be requested to take a welding test

H. Plan your interview day so that you will have plenty of time for the interview, the welding test, and, if required, the physical

(NOTE: Planning other activities for the same day as a job interview may burden you with distracting thoughts that adversely affect your chances for getting a job.)

XIII. Guidelines for succeeding with a welding test (Transparency 1)

A. Get a good rest the night before the test

B. Pay careful attention to directions given by the supervisor giving the test, and if a written procedure is used, read it carefully before starting the test

INFORMATION SHEET

C. Take your own gear with you because you will be more comfortable with your own gloves and cutting goggles, and the lens shade in your helmet should be the one with which you have learned to work safely and comfortably

D. Make sure the gear you do take is in good order because dirty or damaged equipment indicates a less than professional attitude and interest

E. In most testing, you will be permitted to run a few practice beads so take advantage of the time to adjust equipment or ask questions about things that do not seem right

F. Always remember that when you get as far as a welding test, you are well on the road to a job, so concentrate on the procedure and finish it properly

G. When the test is finished, thank the supervisor for helping, and follow directions for whatever the job-getting process requires next

(NOTE: As you train for a welding job, keep in mind the items in the testing procedure outlined in Transparency 1 for these are some of the skills you should concentrate on.)

XIV. Guidelines for completing a medical questionnaire (Assignment Sheet #5)

A. Answer all questions

B. Ask questions about anything you do not understand

C. Use notes to explain "yes" answers that need clarification

Example: If you are taking prescribed medicine for relief of a temporary condition such as a cold or a nonrecurring problem, make a note to indicate the condition is temporary

Welding Test Procedure

APPLICANT EVALUATION TEST

NAME: ______________________ DATE: ____________

Activity	Good	Fair	Marginal	Poor
Setting Power Source				
Tacking Test Plates				
Striking Arc				
Uniform Bead Appearance				
Undercut				
Surface Porosity				
Restarts				
Weld Termination				
Equal Leg Length				
Overlap				

REMARKS: ______________________________

TESTED BY: ______________________________

APPLYING FOR A WELDING JOB
UNIT VI

ASSIGNMENT SHEET #1 — COMPLETE A SOCIAL SECURITY CARD APPLICATION

Directions: Use the guidelines in the information sheet and the following sample social security card application form to complete an application for a social security card.

(NOTE: Should you need a social security number, use this application as a guideline, but the application itself should be made at your local or area social security office so that it will be on paper designed for computer processing.)

ASSIGNMENT SHEET #1

SAMPLE SECURITY CARD APPLICATION

DEPARTMENT OF HEALTH AND HUMAN SERVICES
SOCIAL SECURITY ADMINISTRATION

Form Approved
OMB No. 0960-0066

FORM SS-5 — APPLICATION FOR A SOCIAL SECURITY NUMBER CARD (Original, Replacement or Correction)

MICROFILM REF. NO. (SSA USE ONLY)

Unless the requested information is provided, we may not be able to issue a Social Security Number (20 CFR 422-103(b))

INSTRUCTIONS TO APPLICANT ▶ Before completing this form, please read the instructions on the opposite page. You can type or print, using pen with dark blue or black ink. Do not use pencil.

NAA — 1 — NAME TO BE SHOWN ON CARD: First / Middle / Last

NAB — FULL NAME AT BIRTH (IF OTHER THAN ABOVE): First / Middle / Last

ONA — OTHER NAME(S) USED

STT — 2 — MAILING ADDRESS (Street/Apt. No., P.O. Box, Rural Route No.)

CTY — CITY | STE — STATE | ZIP — ZIP CODE

CSP — 3 — CITIZENSHIP (Check one only)

- ☐ a. U.S. citizen
- ☐ b. Legal alien allowed to work
- ☐ c. Legal alien not allowed to work
- ☐ d. Other (See instructions on Page 2)

SEX — 4 — SEX

- ☐ MALE
- ☐ FEMALE

ETB — 5 — RACE/ETHNIC DESCRIPTION (Check one only) (Voluntary)

- ☐ a. Asian, Asian-American or Pacific Islander (includes persons of Chinese, Filipino, Japanese, Korean, Samoan, etc., ancestry or descent)
- ☐ b. Hispanic (includes persons of Chicano, Cuban, Mexican or Mexican-American, Puerto Rican, South or Central American, or other Spanish ancestry or descent)
- ☐ c. Negro or Black (not Hispanic)
- ☐ d. Northern American Indian or Alaskan Native
- ☐ e. White (not Hispanic)

DOB — 6 — DATE OF BIRTH ▶ MONTH / DAY / YEAR

AGE — 7 — PRESENT AGE

PLB — 8 — PLACE OF BIRTH ▶ CITY / STATE OR FOREIGN COUNTRY / FCI ☐

MNA — 9 — MOTHER'S NAME AT HER BIRTH: First / Middle / Last (Her maiden name)

FNA — FATHER'S NAME: First / Middle / Last

PNO — 10 — a. Has the person listed in item 1 above or anyone acting on that person's behalf ever applied for a Social Security number card before? ☐ YES(2) ☐ NO(1) ☐ Don't know(1) If yes, when: → MONTH / YEAR

b. Was a card received? ☐ YES(3) ☐ NO(1) ☐ Don't know(1) **If you checked yes to a or b, complete items c through e; otherwise go to item 11.**

SSN — c. Enter Social Security number ☐☐☐–☐☐–☐☐☐☐

NLC — d. Enter the name shown on the most recent Social Security card.

PDB — e. Date of birth correction (See Instruction 10 on page 2) ▶ MONTH / DAY / YEAR

DON — 11 — TODAY'S DATE ▶ MONTH / DAY / YEAR

12 — Telephone number where we can reach you during the day. Please include the area code ▶ HOME / OTHER

ASD — **WARNING: Deliberately furnishing (or causing to be furnished) false information on this application is a crime punishable by fine or imprisonment, or both.**

13 — YOUR SIGNATURE

14 — YOUR RELATIONSHIP TO PERSON IN ITEM 1 ☐ Self ☐ Other (Specify) ____________

WITNESS (Needed only if signed by mark "X")

WITNESS (Needed only if signed by mark "X")

DO NOT WRITE BELOW THIS LINE (FOR SSA USE ONLY)

SSN ASSIGNED ☐☐☐–☐☐–☐☐☐☐

DTC — SSA RECEIPT DATE

NPN

DOC | NTC | CAN | BIC

TYPE(S) OF EVIDENCE SUBMITTED

IDN | ITV

☐ MANDATORY IN PERSON INTERVIEW CONDUCTED

SIGNATURE AND TITLE OF EMPLOYEE(S) REVIEWING EVIDENCE AND/OR CONDUCTING INTERVIEW

DATE

DATE

DCL

FORM **SS-5** (8-80)

3

ASSIGNMENT SHEET #1

HOW TO APPLY FOR A SOCIAL SECURITY NUMBER CARD
(Original, Replacement or Correction)

This application can be used to apply for a Social Security number for the first time, to get a replacement for your card, or change any information on your record. Before you begin to complete this application, please read the information below, the completion instructions on page 2 and the information about the Privacy Act on page 4 of this form.

WHERE TO APPLY

You may apply either by mailing your documents and forms to the nearest Social Security office or by bringing them in person. However, you must apply *in person* at a Social Security office if:

1. You are age 18 or older and have never had a Social Security number card before, or
2. You are an alien whose immigration documents should not be mailed.

EVIDENCE YOU WILL NEED

The Social Security law requires that you furnish evidence of your age, identity, and U.S. citizenship or lawful alien status when you apply for a Social Security card. The evidence you must submit will depend on your circumstances. There are four different categories described below. Find the one which applies to you and then read the instructions carefully.

You must submit original or certified documents as evidence — we cannot accept uncertified or notarized photocopies. We will return all documents submitted. NOTE: all documents submitted as evidence may be retained temporarily and verified with the custodian of the original records.

If you have any questions or need help in obtaining your documents, please call or visit your nearest Social Security office.

1. U.S. Citizen — Born in the U.S.
Applying for Original Social Security Number

Please submit one document from List A **and** at least one from List B.

List A. Evidence of Age and Citizenship

One of the following records established before your 5th birthday:

- Public or hospital birth certificate
- Religious record of birth or baptism

If your birth was never recorded or the public record no longer exists, submit documents from list B for evidence of age and citizenship. At least one document must show your name, age or date of birth, and your place of birth. It should be at least one year old.

List B. Evidence of Identity (A birth record is not evidence of identity.)

- State identity card
- Insurance policy
- Driver's license
- School ID card
- Vaccination certificate
- Adoption record
- School record or report card
- Clinic, doctor or hospital record
- Marriage or divorce record
- Work badge or building pass
- Voter's registration card
- Military or draft record
- Newspaper notice of birth
- Prior Welfare ID card
- Military dependent's ID
- U.S. passport or citizen ID card
- Church membership or confirmation record
- Day care or nursery school record
- Court order for name change
- Labor union or fraternal organization record
- Record of child's membership in Boy Scouts, Girl Scouts or other youth organization
- Any other document providing identifying data such as physical description, photograph, or signature

2. U.S. Citizen — Born Outside the U.S.
Applying for Original Social Security Number

If you were born outside the U.S. but are a U.S. citizen, you should submit either:

a. U.S. consular report of birth **and** evidence of your identity (see category 1, list B), or
b. Your foreign birth certificate (if available) **and** one of the following:
  - U.S. citizen ID card
  - U.S. passport
  - Certificate of citizenship
  - Naturalization certificate
  - U.S. military discharge papers showing U.S. citizenship

3. Alien — Not a U.S. Citizen
Applying for Original Social Security Number

If you are an alien living in or visiting the U.S., you should bring in your foreign birth certificate (if available) and one of the following:

- Alien Registration Card I-151 or I-551
- U.S. Immigration Form I-94, I-95, I-185, I-186 or I-586 (and I-444 if applicable.)

NOTE: Do not mail these documents — bring them in.

We can assign you a Social Security number to use for work only if you are a permanent resident alien or are otherwise authorized to work by the Immigration and Naturalization Service (INS).

If you are a lawfully admitted alien *but not permitted to work* and you have a valid need for a Social Security number for a reason other than work, we will issue you a number. However, we will mark your record and the card will show that the number is not valid for employment. If you ever use the number in a job, we will notify INS of the unauthorized work. In addition, any information obtained in connection with this application can be given to INS.

4. Any Applicant Requesting a Correction or Replacement Card

You must present at least evidence of your identity such as one or more of the documents in categories 1 (List B), 2 or 3. If you are foreign-born (or U.S. born but no longer a U.S. citizen), you must also submit evidence of your current U.S. citizenship or alien status. After we examine your documents, you may be asked for additional evidence of your age or U.S. citizenship or alien status.

If you are **changing your name**, you must provide evidence identifying you under both your **old** and **new** names. We will accept one document if it shows both the old and new names or multiple documents if each shows only one name. If the name change is due to marriage or divorce, your marriage certificate or divorce decree is usually sufficient if the document shows both your previous and new names.

BEST COPY AVAILABLE

APPLYING FOR A WELDING JOB
UNIT VI

ASSIGNMENT SHEET #2 — PREPARE A PERSONAL RESUMÉ

Directions: Use the guidelines in the information sheet and the example that follows to prepare a personal resume.

Name: Pat L. Smith
Address: 777 E. Adams Street
Anytown, USA 74074

Telephone: (405) 377-3303

(This space may be used for a wallet-size photograph)

Age: 18
Height: 5′ 10″
Weight: 165 pounds
Health: Excellent
Marital Status: Single

Education: Expect to be graduated from high school in May, 19_____

Subjects Studied:
Basic Drafting — 2 semesters
Shop Math — 1 semester
Oxyacetylene Welding — 1 semester
Shielded Metal Arc Welding — 2 semesters
(Completed 7 personal projects)
TIG Welding — 1 semester
Welding Blueprint Reading and Layout — 1 semester

Student Activities:
Spring league softball
Vice President, VICA
Students of Science Club

Work Experience:
A-1 Drug Store, stocking clerk, Summer, 19_____
Simms Portable Buildings, helper and assembler, Summer, 19____
Gregory Trailer Company, welder's helper, Summer, 19_____, and weekends during school

References:
Dr. Jim Evans
Pineview Medical Clinic
1600 Pineview
Anytown, USA 74074

Mr. Walter Simms
Simms Portable Buildings
4850 Mason Avenue
Anytown, USA 74074

Mr. Clay Gregory
Gregory Trailer Company
711 Quarter Horse Lane
Anytown, USA 74074

ASSIGNMENT SHEET #2

RESUMÉ

Name: ______________________________

Address: ______________________________
(Street) (City)

____
(State) (Zip Code)

Telephone: ( ) ______________________________

Age: ______________

Height: ______________

Weight: ______________

Health: ______________

Marital Status: ______________

Education:

Subjects Studied:

Student Activities:

ASSIGNMENT SHEET #2

Work Experience:

References:

APPLYING FOR A WELDING JOB
UNIT VI

ASSIGNMENT SHEET #3 — WRITE A LETTER REQUESTING A JOB INTERVIEW

Directions: Use the guidelines in the information sheet and the sample letter that accompanies this assignment sheet to prepare your own letter requesting a job interview.

ASSIGNMENT SHEET #3

Sample Letter for Requesting an Interview

Mr. Kellan Fortney
Personnel Director
Acqua-Weld Industries, Inc.
1700 Lakeshore Drive
Vacationaland, USA 73107

Dear Mr. Fortney:

Your advertisement for a welding job in the Sunday edition of the Lakeside Gazette interests me because my welding program at Twin-Lakes Vo-Tech School emphasizes most of the requirements you listed.

My grades in the two-year welding program at Twin Lakes have been good, especially in oxy-acetylene welding and cutting and shielded metal arc welding. Blueprint reading and layout is included in my studies, and our class projects have included building two different types of boat trailers.

School will end in about six weeks, and I am sincerely interested in going to work as a welder. The enclosed resumé lists other qualifications and references.

My mailing address is 777 E. Adams, Anytown, USA 74074, and my home telephone is (405) 377-3303.

Acqua-Weld Industries has an excellent reputation, and I am looking forward to interviewing for the job.

Sincerely yours,

Pat L. Smith

Encl. 1

ASSIGNMENT SHEET #3

LETTER REQUESTING A JOB INTERVIEW

APPLYING FOR A WELDING JOB
UNIT VI

ASSIGNMENT SHEET #4 — COMPLETE AN APPLICATION FOR EMPLOYMENT AS A WELDER

Directions: Use the guidelines in the information sheet and the following application for employment to complete an application for employment as a welder.

(NOTE: To properly complete the following application form, you will need names, addresses, and telephone numbers that you may have to look up, so your instructor may request that you complete this application at home or at a later date when you are prepared to properly list all the information required.)

ASSIGNMENT SHEET #4

JOB APPLICATION FORM

ROBBERSON STEEL COMPANY

Application For Employment

(PLEASE PRINT)

Qualified applicants are considered for all positions without regard to race, color, religion, sex, national origin, age, marital or veteran status, or the presence of a non-job-related medical condition or handicap.

Date of Application ____________

Position(s) Applied For ____________

Referral Source: ☐ Advertisement ☐ Friend ☐ Relative ☐ Employment Agency ☐ Other

Name ____________ LAST FIRST MIDDLE

Address ____________ NUMBER STREET CITY STATE ZIP CODE

Phone No. (   ) ____________ AREA CODE Social Security No. ____________

Have you filed an application here before? ☐ Yes ☐ No Date ____________

Have you ever been employed here before? ☐ Yes ☐ No Date ____________

Are you a citizen of the United States? ☐ Yes ☐ No

If not, do you possess an Alien Registration Card? ☐ Yes ☐ No

If yes, give Alien Registration Number ____________

Are you available to work? ☐ Full Time ☐ Part Time ☐ Shift Work

Are you on lay-off and subject to recall? ☐ Yes ☐ No

Are you? ☐ Under 18 ☐ 18-70 ☐ Over 70 years of age

Do any of your friends or relatives, other than your spouse, work here? ☐ Yes ☐ No

If yes, list name(s) ____________

Have you been convicted of a felony within the last 7 years? ☐ No ☐ Yes

If yes, explain ____________

AN EQUAL EMPLOYMENT OPPORTUNITY EMPLOYER M/F/V/H

ASSIGNMENT SHEET #4

Are you a veteran of the U.S. military service? ☐ Yes ☐ No Rank________

If yes, what was your Branch of U.S. military service? ____________________

Do you have any physical, mental or medical impairment or disability that would limit your job performance for the position for which you are applying? ☐ Yes ☐ No

If yes, please explain ____________________

What foreign languages do you speak, read and/or write?

	FLUENTLY	GOOD	FAIR
SPEAK			
READ			
WRITE			

List professional, trade, business or civic activities and offices held. (Exclude groups which indicate race, color, religion, sex or national origin):

Give name, address and phone number of three references not related to you.

Special Employment Notice To Disabled Veterans, Vietnam Era Veterans, And Individuals With Physical Or Mental Handicaps

Government contractors are subject to Section 402 of the Vietnam Era Veterans Readjustment Act of 1974 which requires that they take affirmative action to employ and advance in employment qualified disabled veterans and veterans of the Vietnam Era, and Section 503 of the Rehabilitation Act of 1973, as amended, which requires government contractors to take affirmative action to employ and advance in employment qualified handicapped individuals.

If you are a disabled veteran, or have a physical or mental handicap, you are invited to volunteer this information. The purpose is to provide information regarding proper placement and appropriate accommodation to enable you to perform the job in a proper and safe manner. This information will be treated as confidential. Failure to provide this information will not jeopardize or adversely affect any consideration you may receive for employment.

If you wish to be identified, please sign below.

☐ Handicapped Individual ☐ Disabled Veteran ☐ Vietnam Era Veteran

Signed ____________________

ASSIGNMENT SHEET #4

Applicant Data Record

(PLEASE PRINT)

Qualified applicants are considered for all positions, and employees are treated during employment without regard to race, color, religion, sex, national origin, age, marital or veteran status, medical condition or handicap.

As employers/government contractors, we comply with government regulations and affirmative action responsibilities.

Solely, to help us comply with government record keeping, reporting and other legal requirements, please fill out the Data Record.

This Data is for periodic government reporting and will be kept in a Confidential File separate from the Application for Employment.

Date ______________________

Position(s) Applied For ____

Referral Source: ☐ Advertisement ☐ Friend ☐ Relative
☐ Employment Agency ☐ Other ______________________

Name ______________________________________ Phone ( ) __________
LAST FIRST MIDDLE AREA CODE

Address ____
NUMBER STREET CITY STATE ZIP CODE

Affirmative Action Survey

Government agencies require periodic reports on the sex, ethnicity, handicapped and veteran status of applicants. This data is for analysis and affirmative action only. Submission of information about a handicap is voluntary.

Check one:
☐ Male ☐ Female

Check one of the following:
Race/Ethnic Group: ☐ White ☐ Black ☐ Hispanic
☐ American Indian/Alaskan Native ☐ Asian/Pacific Islander

Check if any of the following are applicable:
☐ Vietnam Era Veteran ☐ Disabled Veteran ☐ Handicapped Individual

Have You Ever Filed a Claim for Workmen's Compensation?
☐ Yes ☐ No

ASSIGNMENT SHEET #4

Education

	Elementary	High	College/University	Graduate/ Professional
School Name				
Years Completed:(Circle)	4 5 6 7 8	9 10 11 12	1 2 3 4	1 2 3 4
Diploma/Degree				
Describe Course Of Study:				
Describe Specialized Training, Apprenticeship, Skills, and Extra-Curricular Activities				

Agreement

I certify that the information provided on the application and the Job Placement Medical Questionnaire (and physical examination, if required) is true and complete, and that any falsification of information or significant omissions may disqualify me from further consideration for employment and may be considered for dismissal from employment if discovered at a later date.

I understand that if offered employment, I will be bound by all company policies, rules, and regulations that may be in effect now or in the future.

I further understand that if employed, that my employment is not being made for a definite period of time and that I will be subject to a probationary period of ninety days which can, at employer's discretion, be extended. During the probationary period, employment may be terminated without notice at any time and for any reason.

I authorize this company to conduct any necessary and reasonable investigation with respect to information on this application (and physical examination, if required) and release this company, my former employers, and personal references from any liability from damage caused by giving and receiving information or opinions as to my employment or character.

Date____________________ ________________________________
(Signature of Applicant)

For Personnel Department Use Only

Arrange Interview ☐ Yes ☐ No

Remarks ____

____________________ ____________________ INTERVIEWER DATE

Employed ☐ Yes ☐ No Date of Employment ______________

Job Title ______________ Hourly Rate/Salary __________ Department __________

By ________________________________ NAME TITLE DATE

ASSIGNMENT SHEET #4

Employment Experience

List each job held. Start with your Present or Last job. Include military service assignments and volunteer activities. (Exclude groups which indicate race, color, religion, sex or national origin.)

1	Company Name	Telephone ( ) –
	Address	Employed (State Month and Year) From To
	Name of Supervisor	Weekly Pay Start Last
	State Job Title and Describe Your Work	Reason for Leaving

2	Company Name	Telephone ( ) –
	Address	Employed (State Month and Year) From To
	Name of Supervisor	Weekly Pay Start Last
	State Job Title and Describe Your Work	Reason for Leaving

3	Company Name	Telephone ( ) –
	Address	Employed (State Month and Year) From To
	Name of Supervisor	Weekly Pay Start Last
	State Job Title and Describe Your Work	Reason for Leaving

4	Company Name	Telephone ( ) –
	Address	Employed (State Month and Year) From To
	Name of Supervisor	Weekly Pay Start Last
	State Job Title and Describe Your Work	Reason for Leaving

Summarize Special Skills and Qualifications
Acquired From Employment Or Other Experience ____________________

BEST COPY AVAILABLE

APPLYING FOR A WELDING JOB
UNIT VI

ASSIGNMENT SHEET #5 — COMPLETE A MEDICAL QUESTIONNAIRE

Directions: Use the guidelines in the information sheet and the following sample medical questionnaire to complete a medical questionnaire concerning your personal health and physical condition.

ASSIGNMENT SHEET #4

Are you a veteran of the U.S. military service? ☐ Yes ☐ No Rank ________

If yes, what was your Branch of U.S. military service? ____________________

Do you have any physical, mental or medical impairment or disability that would limit your job performance for the position for which you are applying? ☐ Yes ☐ No

If yes, please explain ____________________

What foreign languages do you speak, read and/or write?

	FLUENTLY	GOOD	FAIR
SPEAK			
READ			
WRITE			

List professional, trade, business or civic activities and offices held. (Exclude groups which indicate race, color, religion, sex or national origin).

Give name, address and phone number of three references not related to you.

Special Employment Notice To Disabled Veterans, Vietnam Era Veterans, And Individuals With Physical Or Mental Handicaps

Government contractors are subject to Section 402 of the Vietnam Era Veterans Readjustment Act of 1974 which requires that they take affirmative action to employ and advance in employment qualified disabled veterans and veterans of the Vietnam Era, and Section 503 of the Rehabilitation Act of 1973, as amended, which requires government contractors to take affirmative action to employ and advance in employment qualified handicapped individuals.

If you are a disabled veteran, or have a physical or mental handicap, you are invited to volunteer this information. The purpose is to provide information regarding proper placement and appropriate accommodation to enable you to perform the job in a proper and safe manner. This information will be treated as confidential. Failure to provide this information will not jeopardize or adversely affect any consideration you may receive for employment.

If you wish to be identified, please sign below.

☐ Handicapped Individual ☐ Disabled Veteran ☐ Vietnam Era Veteran

Signed ____________________

IW-475

ASSIGNMENT SHEET #4

Applicant Data Record

(*PLEASE PRINT*)

Qualified applicants are considered for all positions, and employees are treated during employment without regard to race, color, religion, sex, national origin, age, marital or veteran status, medical condition or handicap.

As employers/government contractors, we comply with government regulations and affirmative action responsibilities.

Solely, to help us comply with government record keeping, reporting and other legal requirements, please fill out the Data Record.

This Data is for periodic government reporting and will be kept in a Confidential File separate from the Application for Employment.

Date ____________

Position(s) Applied For ____________

Referral Source: ☐ Advertisement ☐ Friend ☐ Relative
☐ Employment Agency ☐ Other ____________

Name ____________ Phone ( ) ____________
LAST FIRST MIDDLE AREA CODE

Address ____________
NUMBER STREET CITY STATE ZIP CODE

Affirmative Action Survey

Government agencies require periodic reports on the sex, ethnicity, handicapped and veteran status of applicants. This data is for analysis and affirmative action only. Submission of information about a handicap is voluntary.

Check one:
☐ Male ☐ Female

Check one of the following:
Race/Ethnic Group: ☐ White ☐ Black ☐ Hispanic
☐ American Indian/Alaskan Native ☐ Asian/Pacific Islander

Check if any of the following are applicable:
☐ Vietnam Era Veteran ☐ Disabled Veteran ☐ Handicapped Individual

Have You Ever Filed a Claim for Workmen's Compensation?
☐ Yes ☐ No

ASSIGNMENT SHEET #4

Education

	Elementary	High	College/University	Graduate/Professional
School Name				
Years Completed:(Circle)	4 5 6 7 8	9 10 11 12	1 2 3 4	1 2 3 4
Diploma/Degree				
Describe Course Of Study:				
Describe Specialized Training, Apprenticeship, Skills, and Extra-Curricular Activities				

Agreement

I certify that the information provided on the application and the Job Placement Medical Questionnaire (and physical examination, if required) is true and complete, and that any falsification of information or significant omissions may disqualify me from further consideration for employment and may be considered for dismissal from employment if discovered at a later date.

I understand that if offered employment, I will be bound by all company policies, rules, and regulations that may be in effect now or in the future.

I further understand that if employed, that my employment is not being made for a definite period of time and that I will be subject to a probationary period of ninety days which can, at employer's discretion, be extended. During the probationary period, employment may be terminated without notice at any time and for any reason.

I authorize this company to conduct any necessary and reasonable investigation with respect to information on this application (and physical examination, if required) and release this company, my former employers, and personal references from any liability from damage caused by giving and receiving information or opinions as to my employment or character.

Date____________________ ____

(Signature of Applicant)

For Personnel Department Use Only

Arrange Interview ☐ Yes ☐ No

Remarks ____

____ __________________

INTERVIEWER DATE

Employed ☐ Yes ☐ No Date of Employment ______________

Job Title __________________ Hourly Rate/Salary ________ Department ________

By ____

NAME TITLE DATE

ASSIGNMENT SHEET #4

Employment Experience

List each job held. Start with your Present or Last job. Include military service assignments and volunteer activities. (Exclude groups which indicate race, color, religion, sex or national origin.)

1	Company Name	Telephone ( ) –
	Address	Employed (State Month and Year) From To
	Name of Supervisor	Weekly Pay Start Last
	State Job Title and Describe Your Work	Reason for Leaving

2	Company Name	Telephone ( ) –
	Address	Employed (State Month and Year) From To
	Name of Supervisor	Weekly Pay Start Last
	State Job Title and Describe Your Work	Reason for Leaving

3	Company Name	Telephone ( ) –
	Address	Employed (State Month and Year) From To
	Name of Supervisor	Weekly Pay Start Last
	State Job Title and Describe Your Work	Reason for Leaving

4	Company Name	Telephone ( ) –
	Address	Employed (State Month and Year) From To
	Name of Supervisor	Weekly Pay Start Last
	State Job Title and Describe Your Work	Reason for Leaving

Summarize Special Skills and Qualifications
Acquired From Employment Or Other Experience ______________________

APPLYING FOR A WELDING JOB
UNIT VI

ASSIGNMENT SHEET #5 — COMPLETE A MEDICAL QUESTIONNAIRE

Directions: Use the guidelines in the information sheet and the following sample medical questionnaire to complete a medical questionnaire concerning your personal health and physical condition.

IW-481

ASSIGNMENT SHEET #5

JOB PLACEMENT MEDICAL QUESTIONNAIRE
QUESTIONARIO MEDICO DE SOLICITANTES

NAME—NOMBRE ____________________ POSITION—POSICIÓN ____________________ DATE—FECHA ____________________

Do you ever have—Tiene usted:	YES OR NO SI O NO
Reactions to medicines—Reacciones a medicinas	
Reactions to oils—Reacciones a aceites	
Reactions to chemicals—Reacciones a quimicos	
Skin rashes or eczema—Salpuido o eczema	

Have you ever had—Ha tenido usted:	YES OR NO SI O NO
Asthma—Asma	
Hay Fever—Romadizo (Fiebre de Heno)	
Bronchitis—Bronquitis	
Shortness of breath in walking—Se le corta la respiración al caminar	
Tightness of chest—Dolores de pecho	
Tuberculosis—Tuberculosis	
Emphysema—Enfisema	
Do you smoke cigarettes—Fuma usted cigarrillos	
Packs per day—Paquetes por dia	
How many years—Por cuantos años	
Have you ever worked in a dusty trade—Ha trabajado en lugares polvorientos	

Have you ever had—Ha tenido usted:	YES OR NO SI O NO
High blood pressure—Alta presión arterial	
Heart trouble—Problemas con el corazón	
Heart attack—Ataque del corazón	
Heart surgery—Cirugia del corazón	
Swelling of ankles—Hinchazón en los tobillos	
Fainting spells—Desmayos	
Varicose Veins—Várices (Venas Varicosas)	

Do you have—Tiene usted:	YES OR NO SI O NO
Stomach ulcers—Ulcera estomacal	
Frequent nausea—Nausea frecuente	
Frequent bowel trouble—Problemas intestinales frecuentes	
Frequent diarrhea—Diarrea frecuente	
Hernia—Hernia	

Have you ever had—Ha tenido usted:	YES OR NO SI O NO
Fits or convulsions—Ataques o convulsiones	
Epilepsy—Epilepsia	
Paralysis—Parálisis	
Numbness of hands/feet—Adormecimiento de las manos y/o de los pies	
Double vision—Visión doble	
Severe headaches—Fuertes dolores de cabeza	
Migraine headaches—Migraña (Jaquecas)	
Dizzy spells—Mareos	
Nervous breakdown—Colapso nervioso	

Have you ever had—Ha tenido usted:	YES OR NO SI O NO
Back trouble—Problemas de la espalda	
Back injury—Lesiones en la espalda	
Back surgery—Cirugia en la espalda	
Back pain on lifting—Dolores de espalda al levantar algo pesado	
Knee surgery—Cirugia en la rodilla	
Swollen joints—Hinchazón en las coyunturas	
Dislocated shoulder—Hombro dislocado	
Rheumatism or arthritis—Reumatismo o artritis	
Fracture of bone—Fractura en los huesos	

	YES OR NO SI O NO
Do you use glasses—Usa gafas (lentes, anteojos)	
For reading—Para leer	
For distance—Para la distancia	
Do you use contact lenses—Usa usted lentes de contacto	
Are you color blind—Sufre usted de acromasia	

	YES OR NO SI O NO
Did you ever have ear surgery—Ha tenido cirugia del oido:	
Do you ever have difficulty in hearing—Tiene usted dificultad para oir	
Have you ever had ear trouble—Ha tenido usted problemas con los oidos	

Have you ever had—Ha tenido usted:	YES OR NO SI O NO
Blood in urine—Sangre en la orina	
Kidney trouble—Problemas de los riñones	
Urination difficulties—Dificultad al orinar	
Bladder trouble—Problemas de la vejiga	

Have you ever had—Ha tenido usted:	YES OR NO SI O NO
Liver trouble—Problemas del higado	
Hepatitis—Hepatitis	
Jaundice—Ictericia	
Gallbladder trouble—Problemas de la vesicula biliar	

Do you have—Tiene usted:	YES OR NO SI O NO
Diabetes or sugar in urine—Diabetes o azucar en la orina	
Thyroid trouble or goiter—Problemas de la tiroides o bocio	
Cancer—Cáncer	

	YES OR NO SI O NO
Do you have anemia—Tiene usted anemia	
Do you bleed easily—Sangra usted facilmente	
Have you ever been treated by radiation—Ha recibido usted tratamientos de radiación	
Have you ever worked with radioactive material—Ha trabajado usted con materiales radioactivos	

	YES OR NO SI O NO
Are you taking medicine regularly—Está tomando usted medicinas regularmente	
Are you using harmful drugs—Está tomando usted drogas peligrosas	
Do you use alcohol regularly—Usa usted bebidas alcohólicas regularmente	
How much—Cuánto	
How often—Con qué frecuencia	

____
SIGNATURE—FIRMA

EXPLANATION OF POSITIVE ANSWERS (BY PERSON REVIEWING FORM)
EXPLIQUE USTED LAS RESPUESTAS AFIRMATIVAS

ADDITIONAL REMARKS
INFORMACIONES ADICIONALES

SIGNATURE OF PERSON REVIEWING FORM ____________________

Printed in U.S.A.

APPLYING FOR A WELDING JOB
UNIT VI

NAME ______________________

TEST

1. Match the terms on the right with their correct definitions.

   _____a. Recognition received for outstanding achievement

   _____b. Clubs or organizations that a person belongs to and participates in

   _____c. Hobbies and pastimes

   _____d. The experience, education, and physical abilities which suit a person for a given job

   _____e. Vocational courses taken and skills acquired there, or skills acquired in on-the-job situations

   _____f. A brief typed summary of one's qualifications and experience that is used in applying for a job

   1. Extra-curricular activities
   2. Resume
   3. Fraternal activities
   4. Vocational preparation
   5. Awards
   6. Qualifications

2. Complete a list of reasons why a worker needs a social security card by circling the word(s) that best completes each statement.

   a. Almost all U.S. companies require workers to have or obtain a social security card or have available (their social security card number) (a valid identification)

   b. Through the social security program, earnings and employee and employer contributions are recorded so that workers will receive (retirement or disability benefits) (unemployment benefits)

   c. In the event of a worker's death, social security records are used to determine (disability payments) (benefits for survivors)

   d. Information from social security records helps the government conduct research programs for (unemployment records) (income distribution) and other areas such as health insurance

3. Complete the following list of information required on a social security card application.

   a. Your name as you use it now

TEST

b. The name given you at birth

c. Your ________________ of birth

d. Your citizenship or alien status

e. Your ________________ of birth

f. Your sex

g. Your mother's name at her birth

h. Your ________________ name

i. Your ________________ address

j. Your ________________ number

4. Select true statements concerning guidelines for filling out a social security application by placing an "X" in the appropriate blanks.

_____a. If you do not know the answer to a question, write "unknown" in the space so it will indicate you did not overlook the question

_____b. Use abbreviations for as many answers as possible

_____c. Include the area code when listing your telephone number

_____d. Sign your name as you usually write it, but do not print your name unless you usually print your signature

_____e. Include brief notes to clarify any information that could be misunderstood

_____f. Complete your application only on Form SS-5 obtained from a social security office because the special paper is designed for machines that process information and xerox copies are difficult to process

_____g. Use the social security application form when applying for a replacement social security card

5. Complete the following list of reasons why beginning welders do get jobs.

a. Experienced welders ________________ or sometimes go into business for themselves and those jobs have to be filled

b. Many jobs for welding machine operators require ________________ training time, and beginners with good basic skills frequently stand as good a chance at these jobs as do experienced welders

TEST

c. Many companies prefer to train welders in their ________________ way of doing things, and some of these companies would rather have ________________ talent than have to retrain an experienced welder who might not be receptive to new materials or processes

d. Beginning welders are often given basic welding jobs that experienced welders don't care to work on, and start at ________________ ________________ that experienced welders might consider too low

6. List four ways to find a job.

   a. ____

   b. ____

   c. ____

   d. ____

7. Complete a list of what employers look for in welding job applicants by circling the word(s) that best completes each statement.

   a. Someone who is (dressed stylishly) (neat and clean)

   b. Someone who has (a good) (an average) attendance record with previous employers or at school

   c. Someone who has (an average accident record) (an accident-free work record) with previous employers

   d. Someone who has taken (average) (minimum) time off in previous employment because of physical or personal problems

8. Select true statements concerning why job applicants need to be well prepared by placing an "X" in the appropriate blanks.

   ______a. Applicants for a welding job not only have to complete a job application form and go through an interview, they frequently have to take a welding test

   ______b. Many companies that hire welders also require that an applicant fill out a medical questionnaire and take a physical which includes a back x-ray

9. Complete a list of guidelines for preparing an effective resumé by circling the word(s) that best completes each statement.

   a. Arrange information in (a logical order) (any order)

   b. Use (an outline form) (a paragraph style) that is brief and to the point

TEST

c. Type the resumé or (have it typed) (print it clearly)

d. Check for proper (grammar and spelling) (names and addresses)

e. List (hobbies) (education), work experience, and extra-curricular activities

f. Limit the resumé to (two pages) (one page) if possible

10. Complete statements concerning effective ways to arrange for a job interview.

a. Telephone:

1) Indicate your interest in the company and the job

2) State your name ________________

3) Review your qualifications ________________

4) Indicate that you will be available for the interview at a time most convenient for the company

5) Have ______________________________________ handy to write down any special instructions or the time set for the interview

6) Double check information by ________________ it to the person with whom you are talking, and thank them for the help before hanging up

b. Letter:

1) Open the letter with a brief reference to the ________________ or reference source that inspired you to want the interview

2) State your qualifications ________________

3) Indicate a telephone number, including area code, where you can be reached during the day, and a ________________ ________________

4) If you send a resumé with your letter, indicate that it is enclosed

5) Use a formal closing, and sign your name or type your name and sign above it

6) Indicate the enclosure below your name

7) Use a typed, standard letter form, and have someone qualified check the letter for spelling, grammar, and overall ________________

TEST

11. Select true statements concerning guidelines for filling out a job application by placing an "X" in the appropriate blanks.

_____a. Read through the form before you start filling it out so you won't duplicate information or have to erase items

_____b. If the application specifies that certain items are to be printed, be sure to print, not write

_____c. Include the area code with your telephone number

_____d. Clarify any information that may be confusing with a brief note

_____e. Take your social security card with you to make sure you know the exact number

_____f. Know your height and weight

_____g. Prepare a list of previous employers' addresses and telephone numbers in advance

_____h. When listing references, do not use personal friends, but do include former teachers, your minister, your doctor or banker, or business persons

_____i. List all experience directly related to the job for which you are applying, even if it was only a short-term after-school or summer job

_____j. Be clever with all your answers, and make yourself look good

_____k. Ask questions when you have any doubt about how a question should be answered

_____l. Be honest when stating your physical condition and include information which might limit conditions under which you can work or certain types of work you cannot accomplish

12. Select true statements concerning guidelines for making a good impression at a welding job interview by placing an "X" in the appropriate blanks.

_____a. Be neat, clean, properly dressed, and ON TIME

_____b. Smoke or chew gum only while you're waiting

_____c. Be positive with your answers, but do not try to oversell your abilities because the welding test you take later will say more about your abilities than words can

_____d. If friends or relatives accompany you, leave them in the car; do not take them with you to the interview _____e. Concentrate on the skills you have that are directly related to the job you are applying for, but mention any basic skills you have with other welding processes, and especially skills you may have in blueprint reading and layout

_____f. Admit that you are nervous, if you are, but sit erect, keep eye contact with the interviewer, and use the best English you are capable of using

_____g. Let the interviewer know that you have brought your own tools along in the event you should be requested to take a welding test

_____h. Plan your interview day so that you will have plenty of time for the interview, the welding test, and, if required, the physical

13. Complete statements concerning guidelines for succeeding with a welding test.

a. Get a good rest _____ _______________ _______________ the test

b. Pay _______________ attention to directions given by the supervisor giving the test, and if a written procedure is used, read it _______________ before starting the test

c. Take _______________ _____ _______________ with you because you will be more comfortable with your own gloves and cutting goggles, and the lens shade in your helmet should be the one with which you have learned to work safely and comfortably

d. Make sure the gear you do take is in _______________ _______________ because dirty or damaged equipment indicates a less than professional attitude and interest

e. In most testing, you will be permitted to _____ ____ _____ _______________ _______________ so take advantage of the time to adjust equipment or ask questions about things that do not seem right

f. Always remember that when you get as far as a welding test, you are well on the road to ____ _____, so concentrate on the procedure and finish it properly

g. When the test is finished, thank the supervisor for helping, and _______________ _______________ for whatever the job-getting process requires next

14. Complete statements concerning guidelines for completing a medical questionnaire.

a. _______________ all questions

b. _____ _______________ about anything you do not understand

c. Use _______________ to explain "yes" answers that need clarification

TEST

15. Use assignment sheets to:

    a. Complete a social security card application.

    b. Prepare a personal resumé.

    c. Write a letter requesting a job interview.

    d. Complete an application for employment as a welder.

    e. Complete a medical questionnaire.

    (NOTE: If these activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

APPLYING FOR A WELDING JOB
UNIT VI

ANSWERS TO TEST

1. a. 5
   b. 3
   c. 1
   d. 6
   e. 4
   f. 2

2. a. Their social security card number
   b. Retirement or disability benefits
   c. Benefits for survivors
   d. Income distribution

3. c. Place or date
   e. Date or place (must not be same as c)
   h. Father's
   i. Mailing
   j. Phone

4. a, c, d, e, f, g

5. a. Retire
   b. Minimum
   c. Own,new
   d. Pay scale

6. Any four of the following:
   a. Classified ads in local and area newspapers
   b. Private employment agencies
   c. State employment offices
   d. Local labor union business office
   e. School instructors and counselors
   f. Working welders
   g. Welding supply firms

7. a. Neat and clean
   b. A good
   c. An accident-free work record
   d. Minimum

8. a, b

9. a. A logical order
   b. An outline form
   c. Have it typed
   d. Grammar and spelling

ANSWERS TO TEST

- e. Education
- f. One page

10. a.
    - 2) Clearly
    - 3) Briefly
    - 5) Pencil and paper
    - 6) Repeating

    b.
    - 1) Ad
    - 2) Briefly
    - 3) Mailing address
    - 7) Neatness

11. a, b, c, d, e, f, g, h, i, k, l

12. a, c, d, e, f, g, h

13. a. The night before
    - b. Careful, carefully
    - c. Your own gear
    - d. Good order
    - e. Run a few practice beads
    - f. A job
    - g. Follow directions

14. a. Answer
    - b. Ask questions
    - c. Notes

15. Evaluated according to guidelines referenced and standards outlined in procedures